

Psychological Sciences Division

FY 1976 Programs

March 1976



OFFICE OF NAVAL RESEARCH
Arlington, Va. 22217

Reproduced From
Best Available Copy

19991004 108

This document is issued primarily for the information of U.S. Government scientific personnel and contractors. It is not considered part of the scientific literature and should not be cited as such.

PSYCHOLOGICAL SCIENCES DIVISION

FOREWORD

This is the eighth year that we have prepared a handout to be distributed to those who attend our annual program reviews. It supplements and supports the oral presentations and insures more comprehensive coverage than is possible from the platform. This year, as in previous years, the review is being conducted in three stages: first, an internal examination at the Division level; second, a discussion-oriented presentation to the R&D hierarchy and principal "users" in the Navy, Marine Corps, DARPA, and DoD; and third, the same presentation to representatives of the other military services, other government agencies, and the broad scientific and technical community.

Two new sections have been added to this year's handout. One is entitled "Completed Work Units." As the title indicates, this section consists of short summaries of research and development efforts (work units) which have been completed since last year's presentation. The second new section is entitled "Related Publications." The decision to include this section was made when it was learned that our previous handouts had led some people to conclude erroneously that ONR reports were the only means by which ONR investigators disseminate their findings. On the contrary, such technical reports receive rather limited primary distribution, for the most part to addressees who are actively involved in associated programs. In this sense, the technical reports serve as preliminary and advance information forwarded to avoid the lengthy lags often associated with archival publication. ONR expects and encourages investigators to publish their research in the open literature, thus submitting their work to the critical review of the broad scientific community and adding to the corpus of scientific knowledge. The references given in the "Related Publications" section constitute the bulk of those which appeared recently. For a number of reasons, we have undoubtedly missed some. We apologize to the reader and to the authors whose writings are not cited. However, we take pride in the number and range of scientific articles published last year which acknowledged ONR support.

With the exception of the addition of the two new sections, the format of the handout is essentially the same as it has been in previous years. Each Work Unit is listed according to an internal control number (the NR number) which is followed by the work unit title. The performing organization (i.e., contractor) and Principal Investigator are listed below the title. Following a short description, such technical reports as have been issued since our last review are cited. The typical citation includes an "AD number" which must be used when ordering reports from the National Technical Information Service. (In some cases, AD numbers were not yet available at press time.) Names and telephone numbers are included in the report for the convenience of those wishing to raise questions or make comments regarding our program.

G.L.B.

Arlington, Virginia
March 1, 1976

TABLE OF CONTENTS

	<u>Page</u>
FOREWORD	i
PSYCHOLOGICAL SCIENCES DIVISION (CODE 450)	1
PERSONNEL AND TRAINING RESEARCH PROGRAMS (CODE 458)	
Personnel Measurement and Evaluation (RR 042-04-01)	1
Occupations and Careers (RR 042-04-02)	4
Training and Education (RR 042-06-01)	6
Civilian Manpower Planning Models (RF 55-521-001)	11
Military Manpower Planning (RF 55-521-002)	12
ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS (CODE 452)	
Organizational Effectiveness (RR 042-08-01)	17
National Security Crisis Management	28
ENGINEERING PSYCHOLOGY PROGRAMS (CODE 455)	
Human Engineering (RR 042-09-01)	33
Performance Effectiveness (RR 042-09-02)	38
Operational Decision Aids (RPN08)	43
COMPLETED WORK UNITS	48
RELATED PUBLICATIONS	77
INDEX	
Contractors	83
Principal Investigators	85

THE PSYCHOLOGICAL SCIENCES DIVISION

Dr. Glenn L. Bryan, Director	692-4425
Miss Anne E. Maker, Staff Assistant	692-4501
Mrs. Sharon L. Knost, Secretary	692-4425

The Psychological Sciences Division is one of seven divisions which comprise the ONR Research Group. It sponsors research that is directed toward advancements in the Defense Research Sciences and improvement in Naval Operations. Research funded by the Division is, almost entirely, conducted under contract by universities, nonprofit institutions, and industrial laboratories. Two major types of programs are supported. First, fundamental knowledge that may solve Navy problems is acquired through support of long-range (6.1) research. Contracts are generally awarded in response to unsolicited proposals. Such proposals are evaluated on their relevance to Navy needs, the scientific merit of the proposed research program, the competence of the investigator, and the facilities available to conduct the proposed research. Second, programs in exploratory (6.2) and advanced development (6.3) are conducted which serve to facilitate the coupling of fundamental psychological research findings with technological developments in personnel, manpower, human engineering and allied fields. The Division's research is managed in three general program areas, Personnel and Training Research, Organizational Effectiveness, and Engineering Psychology.

PERSONNEL AND TRAINING RESEARCH PROGRAMS (Code 458)

Dr. Marshall J. Farr, Director	692-4504
Dr. Joseph L. Young, Assistant Director	692-4504
Mrs. Margaret P. Mickelson, Secretary	692-4504

These programs are managed under five headings called Task Areas. Three are funded by the 6.1 (Research) budget category. They are: Personnel Measurement and Evaluation, Occupations and Careers, and Training and Education. The 6.2 (Exploratory Development) budget category supports the work managed under the remaining two headings: Civilian Manpower Planning Models, and Military Manpower Planning.

TASK AREA: Personnel Measurement and Evaluation

Personnel Measurement and Evaluation focuses on improved testing techniques, the derivation of job-aptitude requirements, and the evaluation of job performance. Currently, special emphasis is being placed upon computerized adaptive ability assessment.

NR 150-364 NEW CRITERIA FOR THE SELECTION AND EVALUATION OF SONAR
TECHNICIANS
Human Factors Research, Inc./Mackie

Substantial changes in sonar equipment capabilities, displays and operating modes, brought about by the submarine threat, make it advisable to reexamine current selection standards and procedures for sonar personnel.

PERSONNEL AND TRAINING RESEARCH PROGRAMS

Sonar systems that will be operated over the next twenty years have been analyzed to determine the impact of their designs on operator performance during search, target detection, tracking and classification. From these analyses, relevant personnel requirements (perceptual, motor, cognitive, interest, physiological) have been hypothesized, and candidate predictor tests identified or constructed. The validity of these tests will be determined, using samples of effective and ineffective operators, as reflected by intermediate criteria that will be developed during the research. Funding: NPRDC

NR 150-369 THE RELATIONSHIP BETWEEN INTELLECTUAL CAPACITY AND READING
 COMPETENCY
 University of Missouri-Kansas City/Carver

This research seeks to distinguish between the effects of low intellectual competence and poor early training as they relate to remedial training in reading at the adult level. Reading improvement will be measured by means of a recently developed technique called programmed prose. (This technique requires the reader to choose between two-word alternatives which appear at regular intervals throughout meaningful running text.) Gain scores will be computed to compare the two categories of readers under conditions where the amount of material to be read is held constant and under conditions where the time spent in reading is held constant. Computer programs have been written to convert plain text into the programmed prose format for experimental implementation on the PLATO IV terminals. Funding: ONR

NR 150-372 DERIVING APTITUDE REQUIREMENTS OF JOBS FROM STRUCTURED JOB-
 ANALYSIS DATA
 Purdue University/McCormick

Social and legal pressures are increasingly demanding that personnel selection and classification decisions be based on job-related tests or procedures which sample the actual knowledge, abilities and skills important to successful job performance. Prior ONR-sponsored research by this contractor, to develop a specific, structured job-analysis approach (termed the PAQ) for describing and quantifying worker-oriented job elements, has shown promise for identifying essential job aptitudes for families of jobs. This research will determine whether, and to what extent, this job-analysis technique can be used as the basis for valid job-selection and classification tests. Aptitude standards for the jobs studied will be developed and converted into an aptitude-test battery. Actual job performance will be used as the criteria to validate the test-battery. Funding: ONR

NR 150-373 IMPLIED ORDERS AS A BASIS FOR TAILORED TESTING
 University of Southern California/Cliff

This research is aimed at development and evaluation of a set of procedures for computerized psychological testing. It is based on a formulation of test response as a set of consistent item-person order relations. The research will develop computer programs which employ a formalized procedure for deducing the probable correctness of responses to test items which have not been presented, from the responses to items which have been answered. It will use artificial and real data to evaluate the procedure's capability to construct responses which would have been given

PERSONNEL AND TRAINING RESEARCH PROGRAMS

to all items from actual responses to a few. The artificial data will be used, for example, to estimate the accuracy with which true scores can be estimated from partial scores, using the computer programs to select items to present to examinees. These data will also be tried out on a data bank of responses of individuals to actual test items. Funding: ONR

Cliff, N. A basic test theory generalizable to tailored testing (Tech. Rep. No. 1). University of Southern California, 1975.

NR 150-382 **COMPUTER-BASED ADAPTIVE MEASUREMENT OF INTELLECTUAL CAPABILITIES**
University of Minnesota/Weiss

This work is designed to improve testing procedures for selection and classification of Navy and Marine Corps personnel. Its objective is to investigate the usefulness of a computer-administered adaptive approach to the development of ability tests, which might then be more accurate and more useful than currently available tests. A primary goal of this research is to identify the best methods of re-designing ability tests for interactive computer administration. A second goal is to determine whether computerized administration of ability tests can improve a person's performance by increasing test-taking motivation and/or by reducing test anxiety. Live computerized testing of college students, high school students and, where feasible, military personnel, will be used in pursuance of all objectives. Computer simulation techniques will be used to extend the live-testing findings, using a simulation model designed to reflect live-testing results. Funding: ONR

NR 150-383 **BIAS-FREE COMPUTERIZED TESTING**
University of Minnesota/Pine

This research is designed to investigate methods for reducing the degree of cultural and ethnic bias in ability tests. Its objectives are to: (1) determine the kinds and extent of bias that exist in currently available ability tests; (2) develop methods for quantifying bias; (3) design and apply methods for reducing bias in ability test scores; and (4) determine the amount of bias reduction due to each method, and select the more promising methods for further research. A further objective of the research is to compare conventional paper-and-pencil administration of tests and administration of tests by interactive computer systems as alternative methods which might differentially affect the degree of bias in ability tests. The approach here will include simulation of interactive computer administration of ability test items, as well as actual computerized administration with live subjects. Funding: ONR

NR 150-384 **FACTOR REGRESSION ANALYSIS**
Navy Personnel R&D Center/Curtis

Personnel selection and classification approaches rely in large part on predicting future performance, usually based on multiple-regression techniques. Classical multiple-regression techniques yield regression weights which are optimal for the individuals sampled, but not for the population from which the sample was drawn. The aim of this research is to conceptualize, design, develop and validate a new method for optimally weighting and selecting statistical predictors in terms of a given population. The method should yield more stable results from sample to sample than previously existing methods. The approach will include working with

PERSONNEL AND TRAINING RESEARCH PROGRAMS

population-data matrices selected from the published literature as well as several actual sets of Navy data. Samples will be generated by Monte Carlo procedures, with sample sizes varying from very large to very small. Each sample will be analyzed by multiple regression as well as by Factor Regression Analysis. Funding: ONR

NR 150-389 COMPUTERIZED ADAPTIVE PERFORMANCE EVALUATION
University of Minnesota/Weiss

This research is designed to (a) investigate the utility of computer-administered, adaptive performance tests in determining whether individuals have successfully completed a training course or units of training; (b) improve the current theoretical basis for the measurement of human performance; (c) develop a number of computer-based performance-evaluation methods, compare these methods with existing paper-and-pencil methods for making the same decisions, and refine those methods which show greatest promise; and (d) develop and refine computer-based performance tests which are not based on the current models of psychometric performance evaluation. The objective of these tests will be to assess aspects of performance which are not now measurable by typically used multiple-choice performance tests, whether computer-administered or paper-and-pencil. The approach is to develop a general psychometric theory for criterion-referenced tests. Computer simulation studies will then be used to investigate some of the properties of the theory. The theory will then be applied to the construction and administration of live, adaptive criterion-referenced tests in two content domains. Prototype, computerized adaptive performance-simulation tests will be developed and administered to live testees, and the measurement properties of these simulated tests will be investigated. Funding: ARPA

TASK AREA: Occupations and Careers

This Task Area is concerned with factors affecting job design, job satisfaction, career motivation and personnel retention. It is also concerned with the relationship between the human-performance demands of jobs, on the one hand, and the abilities and aptitudes of individuals, on the other.

NR 151-370 EVALUATION OF MARINE CORPS TASK ANALYSIS PROGRAM
California State University/Stone

This research seeks to provide a thorough evaluation of the Marine Corps Task Analysis Program through intensive study in several research areas. The central goal is to determine the efficacy of the task analysis (T.A.) process as it is currently performed (i.e., preparation of inventories based upon observation, interview, and experts' inputs; on-site administration of inventories), and to suggest improvements. An additional aim is to explore ways in which the T.A. system can be most effectively applied to improve classification, assignment, training, job satisfaction, etc. So far, the Task Analysis Program has been analyzed, compared with other job analysis systems, and literature reviewed. Both quantitative and qualitative methods are being used in data analysis. The methodologies are varied and numerous because of division of the study into eight research areas. Experimental and control groups are used to test hypotheses in

PERSONNEL AND TRAINING RESEARCH PROGRAMS

several areas. Statistical methods include tests of significance of differences between groups, correlation, analysis of variance, tests of stability in determining sample size, and the use of algorithms in cluster analysis. Funding: USMC

NR 151-375 ENHANCING THE ABILITY-PERFORMANCE RELATIONSHIP: A STUDY OF
SOME FACTORS AFFECTING TOTAL GROUP AND DIFFERENTIAL
VALIDITY
University of Maryland/Schneider

This work is studying the moderating effects of certain "non-ability" variables and selected contextual variables on relationships between a worker's abilities and job performance. The objective is to achieve more accurate predictions of job performance at the time of initial selection of personnel. In particular, both the non-ability and contextual variables will be examined to clarify inconsistent findings in the literature regarding the validity of ability tests in radically heterogeneous samples of employees. Data are being collected from a variety of different groups (e.g., bank employees and policemen) to study the effects of three non-ability variables (need for achievement, self-esteem and Internal-External locus of control) and four contextual variables (nature of reward system, leadership behavior, role conflict and job characteristics) on the ability-performance relationship. Funding: ONR

NR 151-377 ORGANIZATIONAL POLICY DECISIONS AS A FUNCTION OF TASK DESIGN
AND INDIVIDUAL ABILITIES, PREFERENCES AND ORIENTATIONS
University of Akron/Barrett

This research program is aimed at development of a model of individual behavior which incorporates and accounts for the complex interactions among individual preferences, orientations, abilities, skills, and motivation in monitoring and maintenance tasks having varied job-structural attributes. A secondary objective is the development of an organizational policy-making model within a cost/benefit framework. This policy model would incorporate potential organizational decisions relative to job design, selection, and training, to achieve valued organizational outcomes (e.g., high quality performance). Objective measures of job-structural attributes will be constructed in an information-processing framework, oriented specifically toward monitoring and maintenance type operations. In addition, measures of job-structural preferences which are independent of specific job content or individual job experience will be refined, to allow for generalization across tasks, and prediction for both job incumbents and younger individuals with little or no actual work experience. The approach here will include laboratory and field studies of industrial organizations as well as experimental simulations of maintenance and monitoring operations. Funding: ONR

NR 151-380 MODELS AND METHODS FOR INTEGRATING AND GENERALIZING HUMAN
PERFORMANCE RESEARCH
University of California, Irvine/Fleishman

The science and technology of human-performance research still lacks a generally accepted set of unifying concepts for the systematic description and prediction of human performance. Such a set of concepts would help us make more dependable generalizations of research results to new tasks. In particular, such a conceptual framework would allow us to generalize

PERSONNEL AND TRAINING RESEARCH PROGRAMS

research findings from laboratory studies to operational settings and from one experimental situation to another. The key problem here, which constitutes the main focus of this research, is the need to generalize the effects of some training, environmental, or procedural condition, based on knowledge of its effects on one task, to its probable effects on some other task. In this tri-service-supported effort, the solution is being pursued by working towards an improved system for classifying such tasks in a way which would lead to better generalization and prediction of human performance. The contractor is performing an intensive review and integration of all work in the area of human abilities, job and task analysis, task-taxonomy systems, and the relationship between task characteristics and ability requirements. Findings, conclusions, and recommendations will be documented in a book-length report. Funding: ONR, ARI, AFOSR

TASK AREA: Training and Education

This Task Area is concerned with enhancing the knowledge base underlying the training and education enterprise in the Navy and Marine Corps. Some topics of current interest are human learning, memory, and cognitive processes (especially individual differences in those processes), and computer-assisted instruction (especially innovative generative and interactive approaches to such instruction).

NR 154-353 A COMPUTERIZED DATA-MANAGEMENT SYSTEM FOR ASSESSING FLIGHT-TRAINING PROGRESS
Rowland and Company, Inc./Rowland

This work is directed at developing improved techniques, data and resources for the individualized management of basic and advanced Navy flight training and of Naval Flight Officers (NFO's). These techniques and data are expected to permit each student to be handled in accordance with his own demonstrated progress, accelerating those who would benefit from reduced syllabus time, and providing tailor-made remedial training to some marginal students. A number of computerized procedures to achieve these ends are in the process of being implemented. Projected benefits to the Navy include reduced flight attritions, less time to achieve successful training, and earlier elimination of probable failures. Funding: BUMED

Marlowe, E., Escobar, D., & Rowland, G. E. Annual report in support of technical development plan 43-03X - education and training (Phase III Rep.). Rowland and Company, Inc., November 1975. (AD A006 102)

NR 154-355 IMPROVING THE ACQUISITION AND UTILIZATION OF SKILLS RELEVANT TO NAVY TECHNICAL TRAINING
University of Southern California/Rigney

This research seeks to develop an adequate theoretical basis upon which to build adaptive, computer-based training systems for teaching equipment operators and maintainers to do their jobs. Emphasis is placed upon teaching those particular job-related interactions with military equipment which can be specified as a series of prescribed actions. For instance, a multi-level hierarchical system, with the capability for presenting information at each level from several different viewpoints,

PERSONNEL AND TRAINING RESEARCH PROGRAMS

has been designed. Some of these tasks also require the learner to use a high degree of mental imagery. Training experiments are being conducted under laboratory conditions to determine the feasibility and effectiveness of performance-oriented, hands-on training under computer control. In a cooperative venture with the Electronic Schools Command (ESC), techniques already developed will be evaluated in the context of training vehicles of interest to the ESC; and a new technical information synthesis, retrieval, and display system will be elaborated. Funding: ONR, ARPA

Rigney, J. W., & Lutz, K. A. The effects of interactive graphic analogies on recall of concepts in chemistry (Tech. Rep. 75). University of Southern California, July 1975. (AD A012 432)

Wollmer, R., & Bond, N. Evaluation of a Markov-decision model for instructional sequence optimization (Tech. Rep. 76). University of Southern California, October 1975. (AD A018 423)

NR 154-360 LEARNING PROCESSES IN NETWORK-BASED, COMPUTER-ORIENTED SELF-CONTAINED EDUCATIONAL SYSTEMS
University of California, San Diego/Norman

Navy teaching problems are compounded by the fact that students come from varying cultural and education backgrounds. They start out with great variability in their initial knowledge and motivation. Network models of human memory, and of the semantic and syntactic structure of the information to be learned, serve as bases for analyzing the specific ways that instructional material must be adapted to the particular student if individualized instruction is to be optimized. Laboratory experiments are contributing to a better understanding of human memory and instructional strategies. Vehicles being used for this work include courses in programming a simple computer language and in Civil War history. Funding: ONR, ARPA

Shimron, J. On learning maps. University of California, September 1975. (AD A017 092)

Gentner, D. R. The structure and recall of narrative prose. University of California, October 1975. (AD A017 093)

NR 154-368 INDIVIDUAL DIFFERENCES IN INFORMATION PROCESSING
University of Oregon/Keele

People have different styles of processing information. If these differences are stable across different tasks, it should be possible to improve personnel selection and training techniques by taking into account each individual's information processing characteristics. Two such differences, fusion and non-fusion of auditory inputs to the two ears (such as PANET and LANET) into a word (such as PLANET) and flexibility of attention, will be studied. The aim will be to arrive at an understanding of the stability of these differences across different tasks using current information-processing theoretical approaches. Early results on word fusion indicated that it was not the simple unitary phenomenon suspected; correlations among alternative "measures" of fusion and between them and other tasks were more modest than anticipated. Planned work on fusion phenomena emanates from the hypothesis that the processing modes underlying fusion and non-fusion can be made available to all subjects. Emphasis will be on experiments in which attentional instructions are varied in an attempt

PERSONNEL AND TRAINING RESEARCH PROGRAMS

to produce a desired processing mode. The work on flexibility of attention will concentrate on the generality of the concept; it will utilize an experimental paradigm, newly devised by the principal investigator, which investigates ability to shift from one task to another. Funding: ONR

Lyons, D. R. Source of individual differences in digit span (Tech. Rep. 1). University of Oregon, September 1975. (AD A018 042)

Keele, S. W., & Lyons, D. R. Individual differences in word fusion: a methodological analysis (Tech. Rep. 2) University of Oregon, September 1975. (AD A018 043)

NR 154-371 FACTOR COMPOSITION AND ATTRIBUTE FUNCTIONING IN MEMORY Northwestern University/Underwood

Different jobs place varying degrees of emphasis on particular types of memory skills. In order to utilize this fact effectively, it is necessary to determine first the way in which memory skills are organized, and to determine their functioning in different situations in which the demands on memory differ. This must include demands on both short-term memory and long-term memory. It should eventually be possible to match the memory capabilities of individuals with particular jobs for which the memory requirements are known. Using a series of relatively simple tasks, scores are being obtained to reflect the role which various types of information or attributes play in memory functioning. A factor analysis of these scores will show the organization of the attributes. Experiments are being carried out to assess the role played by the various attributes in situations in which short-term memory demands are heavy, and in other situations in which the demands are light. In another series of experiments, a determination is being made of the role played by attributes in discriminating among specific long-term memories. Funding: ONR

Underwood, B. J., Kapelak, S. M., & Malmi, R. A. The integration of discrete verbal units in recognition memory Northwestern University, September 1975. (AD A016 942)

Underwood, B. J., Kapelak, S. M., & Malmi, R. A. The spacing effect: additions to the theoretical and empirical puzzles Northwestern University, September 1975. (AD A016 855)

Underwood, B. J., Kapelak, S. M., & Malmi, R. A. Recognition memory for pairs of words as a function of associative context Northwestern University, September 1975. (AD A016 943)

NR 154-374 MAN-MACHINE COMMUNICATIONS PROCESS RESEARCH University of Southern California/Mann

People communicate with computers by using skills transferred and adapted from interpersonal communication. Current scientific knowledge of these skills is not adequate to serve as a basis for designing man-machine communication schemes. Present-day man-machine communication is typically difficult for non-computer-professionals because of rigid, narrow and unnatural forms of expression. A major objective of this project is to develop a basic computer model of human communication capabilities. The methodology entails a rigorous kind of case analysis. Human dialogues are being transcribed and subjected to a structural encoding process by one or more trained observers. A computer program is being constructed for each such dialogue with the encoded transcript as the program's input.

PERSONNEL AND TRAINING RESEARCH PROGRAMS

Some of the programmed sub-processes invented for one dialogue will turn out to be reasonable on others. The repeatedly effective processes are the key candidates for transfer to non-research computer systems where they can facilitate easy communication with people. This should be particularly useful in computer-assisted instruction. Funding: ARPA

Mann, W. C., Moore, J. A., Levin, J. A., & Carlisle, J. H. Observation methods for human dialogue University of Southern California, June 1975. (AD 0137 242)

Carlisle, J. H. A tutorial for use of the tenex electronic notebook-conference (TEN-C) system on the ARPANET University of Southern California, July 1975.

Gallenson, L. An approach to providing a user interface for military computer-aided instruction in 1980 (Tech. Rep. 75-43). University of Southern California, November 1974.

Martin, T. H., Stanford, M. C. Carlson, F. R., & Mann, W. C. A policy assessment of priorities and functional needs for the military computer-assisted instruction terminal (Tech. Rep. 75-44). University of Southern California, December 1975.

NR 154-376 APTITUDES AND INSTRUCTIONAL METHODS: INDIVIDUAL DIFFERENCES IN LEARNING-RELATED PROCESSES
Stanford University/Snow

If the aptitudes of a learner can be shown to interact with methods of instruction, this fact can be exploited in the design of Navy and Marine Corps individualized instruction. Previous attempts to isolate and understand these interactions have proved disappointing. This effort is aimed at developing adequate theories to predict, in detail, the nature and extent of the interaction. At each step in the theory formulation, experiments are conducted to challenge the theory. Standard ability tests and laboratory learning tasks have been analyzed and experiments are being conducted to investigate hypotheses derived from contemporary information-processing models of cognition and memory. Current emphasis is on the examination of two hypothesized types of ability: one, called "fluid-analytic" (e.g., perceptual tasks) and the other called "crystallized-verbal" (e.g., following the rules for manipulating symbolic information). Funding: ONR, ARPA

NR 154-378 INDIVIDUAL DIFFERENCES IN COGNITIVE PROCESSING
Yale University/Day

Some individuals are language-bound (LB): their thinking is constrained by the rules of their language. They unconsciously follow these rules even when this approach produces misconceptions of actual events. Other individuals are language-optional (LO): they can allow themselves to be governed by the rules of their language or set them aside depending on task demands. These two types of individuals show systematic differences in a variety of perception and memory tasks. This research seeks to determine whether the distinction is specific to language or is based on a more general tendency to rely on schemas (abstract structures) in a variety of domains, including pictures and music as well as language. This distinction may eventually be useful in selection and training in the Naval establishment. A large group of individuals will be identified, half LB and half LO. They will participate in a series of perception,

PERSONNEL AND TRAINING RESEARCH PROGRAMS

memory and concept formation experiments. Each type of experiment will be repeated a number of times, each time with a different type of stimulus materials. In the auditory experiments, speech, music, environmental noises, and artificial sounds will be used. In the visual experiments, speech, music, environmental noises, and artificial sounds will be used. In the visual experiments, letters, cartoons, and photographs will be used. The extent to which individuals devise, use, and become bound by abstract codes will be observed across all types of materials. Funding: ONR

NR 154-379 TEACHING CAUSAL KNOWLEDGE AND REASONING BY COMPUTER
Bolt, Beranek and Newman, Inc./Collins

Future instructional systems in the Navy and Marine Corps will be enhanced if methodologies can be developed for effective use of generative computer-assisted instruction (CAI), i.e., CAI which generates instruction on-line from a data base or representation of the subject matter. This work has three main objectives: (1) to develop generative CAI systems for tutoring causal knowledge and reasoning, (2) to develop a computational theory of tutoring, and (3) to evaluate the effectiveness of different strategies for tutoring causal knowledge and reasoning. In the work done under this contract, generative CAI systems are implemented in the LISP programming language on a PDP-10, using various tools (e.g., semantic networks and parsers) available at Bolt, Beranek and Newman. The theory of tutoring is derived from an analysis of human dialogues in terms of how the human tutoring strategies can be implemented in a computer. The evaluation is carried out by comparing students' learning as a function of different tutoring strategies. Funding: ONR, ARPA

Collins, A. Processes in acquiring knowledge. Bolt, Beranek and Newman, Inc., January 1976.

NR 154-381 CURRICULUM-INFORMATION NETWORKS FOR COMPUTER-ASSISTED
INSTRUCTION
Stanford University/Suppes & Wescourt

A Curriculum Information Network is a formal means for specifying relationships between parts of a computer-assisted instruction (CAI) curriculum. It provides a framework for modeling a student's progress through a course in terms of his acquisition of specific skills. This research is aimed at improving the effectiveness of tutorial CAI by comparing different algorithms for individualized selection of instructional material, based on the different student models within a Curriculum Information Network framework. The vehicle for this investigation will be the BASIC Instructional Program (BIP), a CAI course for teaching the BASIC programming language, and its associated Curriculum Information Network, both developed under previous ONR support. A number of different types of student models will be explored, and task selection algorithms derived from them. The effectiveness of these models and algorithms as bases for instructional decisions will be evaluated, using a computer simulation procedure incorporating characteristics of previous students in the BIP course. Thus the simulation will allow the determination of how effective a given task selection algorithm (TSA) would have been in producing learning among students who actually completed the BIP curriculum using a different TSA. Funding: ONR

PERSONNEL AND TRAINING RESEARCH PROGRAMS

NR 154-385 CONFERENCE ON READING AND READABILITY RESEARCH IN THE ARMED SERVICES
Human Resources Research Organization/Sticht

All three Services are concerned with the issue of the mismatch between the reading skills of many of its personnel and the difficulty/complexity level of the material to be read. The problem impacts on both the marginal reader and personnel reading anywhere below high-school level. A three-day Conference was held to bring together experts from civilian R&D centers with R&D specialists and operational personnel from within the Armed Services for focused discussion on reading and readability problems in the Services. A post-conference tri-Service working group is considering the proceedings of the conference and developing a report for wide-scale dissemination and use within and outside of the military services to suggest directions for R&D on the fundamental, persistent problems of reading and readability in the Armed Services. Funding: ONR, NPRDC, ARI, AFOSR

NR 154-386 MEASUREMENT AND ANALYSIS OF PERCEPTUAL AND COGNITIVE ABILITIES IN VERBAL INFORMATION PROCESSING
Bolt, Beranek and Newman, Inc./Frederiksen

Navy and Marine Corps jobs rely to differing extents on reading and verbal information processing. This research is aimed at the delineation and refinement of performance measures that reflect basic component processes in reading and verbal information processing. These measures are designed to be independent of irrelevant factors pertaining to cultural background, and to provide the analytic information about basic skills needed to determine causes of adult cognitive deficiencies and to develop methods for improving reading and information-processing skills. Experiments will be conducted to establish the reliability and construct validity of the proposed measures, and to determine their relationship to an individual's general proficiency in reading, and to other conventional measures of cognitive ability and verbal comprehension. Subjects for these controlled laboratory experiments will be late high-school and college age students of a number of different levels of reading skill. The experiments will typically ask how long it takes a subject to complete a specific component process. Funding: ONR

TASK AREA: Civilian Manpower Planning Models

This Task Area seeks to develop suitable models and computer software for solutions to civilian manpower planning and forecasting problems. A major objective here is to provide Navy personnel and manpower managers with the capability to use computers in an on-line interactive mode to help them in their day-to-day decisions.

NR 155-339X MATHEMATICAL METHODS IN MANPOWER MANAGEMENT
University of Texas/Charnes

The purpose of this research is to refine and experimentally implement several mathematical models for estimating and analyzing future civilian manpower needs in the Navy. Existing models have been developed jointly by the Navy's Office of Civilian Manpower Management (OCMM) and ONR

PERSONNEL AND TRAINING RESEARCH PROGRAMS

contractors. The current effort is aimed at developing the necessary inter-connectives to sequence the models for on-line computer integration. Initial targets for study include the effects of age distribution, manpower needs, ceilings and financial budgeting on OCMM's planning program.
Funding: ONR

Ben-Tal, A., & Zlobec, S. Convex programming and the lexicographic multi-criteria problem (CCS Rep. 228). University of Texas, April 1975.

Armstrong, R. D., & Frome, E. L. A comparison of two algorithms for absolute deviation curve fitting (CCS Rep. 229). University of Texas, April 1975.

Yu, P. L., & Leitmann, G. Confidence structures in decision making (CCS Rep. 231). University of Texas, June 1975.

NR 155-359 OPERATIONAL APPLICATIONS OF MANPOWER MODELS Office of Civilian Manpower Management/Niehaus

This effort provides funds to the Navy's Office of Civilian Manpower Management to develop techniques and the software capability to enable Navy civilian-personnel managers to use computers in conversational (interactive) modes for day-to-day manpower allocation and planning. A specialized linear-programming matrix generator is being developed to support various configurations of manpower models formulated previously under ONR sponsorship. Funding: ONR

Bres, E. S., & Niehaus, R. J. An integrated workload and manpower planning system for the Naval Air Rework Facility, North Island (Tech. Rep. 21). Office of Civilian Manpower Management, November 1974. (AD A006 293)

Niehaus, R. J., Sholtz, D., & Thompson, G. L. Managerial tests of conversational manpower planning models (Tech. Rep. 22). Office of Civilian Manpower Management, April 1975. (AD A010 825)

Charnes, A., Cooper, W. W., Lewis, K. A., & Niehaus, R. J. A multi-objective model for planning equal employment opportunities (Tech. Rep. 23). Office of Civilian Manpower Management, October 1975. (AD A018 454)

TASK AREA: Military Manpower Planning

This Task Area is devoted to the conduct of a special ONR exploratory development program, the objectives of which are to support planning and action agencies in the effective manning of the Navy and USMC. Major thrusts include: (a) attrition of first-term enlisted personnel and (b) long-term prediction of manpower supply and demand. The first includes such problems as premature losses due to disciplinary matters, recruiting errors, failures in training, and maladjustment to Navy life. The second thrust includes problems of long-range, detailed manpower forecasting. The content and quality of this program are determined by an interdisciplinary committee which includes representatives of: ASN(M&RA), ONR, OPNAV, CND, BUPERS, CNET, CRUITCOM, MARCORPS and NPRDC. The contracts (work units) are assigned to appropriate Scientific Officers in the Psychological Sciences and Mathematical and Information Sciences Division.

PERSONNEL AND TRAINING RESEARCH PROGRAMS

NR 156-002X ECONOMETRIC RESEARCH ON NAVY MANPOWER PROBLEMS
The George Washington University/Stewart

The work continues a developmental effort to provide the Navy and Marine Corps with techniques for better understanding economic and other factors influencing manpower supply, i.e., enlistment and reenlistment behavior. Examples of recent specific studies include: (a) an in-depth analysis of attrition among first-term personnel; (b) an examination of income differentials, by skill area, among Navy and civilian work forces; (c) an assessment of personal factors influencing retention and trainability. Funding: ONR

Haber, S. E. Occupational structure in the military and civilian sectors of the economy (Tech. Rep. TR-1224). The George Washington University, 25 September 1974. (AD 787 806)

Kyriakopoulos, I. Toward the development of a Navy-Census occupational dictionary (Tech. Rep. TR-1247). The George Washington University, 28 March 1975. (AD A012 403)

Haber, S. E., & Stewart, C. T., Jr. The responsiveness of reenlistment to changes in Navy compensation (Tech. Rep. TR-1254). The George Washington University, 5 May 1975. (AD A012 437)

Haber, S. E. An application of discriminant analysis to the problem of assigning variable reenlistment bonuses (Tech. Rep. TR-1234). The George Washington University, 8 September 1975. (AD A016 639)

NR 156-024X MATHEMATICAL AND ECONOMICAL MODELING FOR MANPOWER PLANNING
University of California, Berkeley/Oliver

This is a continuing effort directed towards the development of a series of interactive computer models for evaluating alternative Navy manpower planning policies and practices. To date the research has completed several models for estimating the stock of personnel in out years according to rate and rating. In addition, a budgetary model has been produced that accounts for future costs associated with anticipated inventory. Current effort is directed towards developing an interactive Force Analysis Simulation Technique (FAST) model. It is hoped that the interactive model, based on a vacancy-driven inventory projection concept, will provide quick responses to manpower managers regarding the feasibility of changing manpower requirements. Funding: ONR

Adler, I., Levin, R., & Oliver, R. M. Longitudinal budget planning models (Tech. Rep. ORC 74-24). University of California, August 1974. (AD 787 604)

NR 156-027X MINORITY RETENTION IN THE NAVY AND MARINE CORPS
University of Pennsylvania/Northrup

This work follows previous research by the contractor on the recruitment of minority personnel for the Navy and Marine Corps. It deals with the services' personnel systems as mechanisms for improving the retention rates of minorities. The analysis has included the study of skill upgrading so that minority personnel may share more equitably in career opportunities throughout the Navy and Marine Corps. Affirmative action policies and practices in industry have been contrasted with those of the services, and the feasibility of using industrial methods has been

PERSONNEL AND TRAINING RESEARCH PROGRAMS

examined. Factors impinging on the upgrading of minority personnel--e.g. promotion criteria and standardized written examinations have been identified. Funding: ONR

Mattison, E. G., III, Northrup, H. R., & Jenkins, F. A., III. Minority upgrading and mobility in the Navy and Marine Corps (Tech. Rep. 3). University of Pennsylvania, August 1975. (AD A014 901)

NR 156-039X PATTERNS OF INDIVIDUAL AND ORGANIZATIONAL ADAPTATION
Tuskegee Institute/Wall

This work has dealt with the processes by which previously white institutions have accommodated the introduction of blacks. Earlier phases of the work, in which data collection techniques were developed and tested, concentrated on two higher-educational institutions. The principal approaches were those of the cultural anthropology, mainly participant observation. The work has shifted its focus to both shore and afloat units at the Naval Base in Mayport, Florida, where the applicability of previous findings is being tested among Naval personnel. Funding: ONR

NR 156-040 CAREER EDUCATION DIFFUSION PROJECT: STATE OF OREGON
Operations Research, Inc./McDermott

This is a follow-on to earlier ONR-funded research by this same contractor on the feasibility of including Navy careers in the career education programs of the U.S. Office of Education and the National Institute of Education. In this work, ORI is attempting to demonstrate, through application to a state-wide career education program in Oregon, the potential for linking the Navy Recruiting Command to a public school career-information system. The approach involves preparing Navy occupational information to the specifications of the Oregon system, as well as production of a demonstration project report designed to facilitate application to other state career programs. Funding: NavCruitCom

McDermott, M. N., Paramore, B., & Callahan, W. T. Work in the Navy--Description of Navy officer and enlisted occupations (Tech. Rep. 923). Operations Research, Inc., June 1975. (AD A011 093)

NR 156-044X INCREASING NAVY PERSONNEL RETENTION THROUGH REVISED CAREER COUNSELING EFFORTS
System Development Corporation/Grace

This is a continuing research activity aimed at improving the Navy's Career Counseling Program--which, in turn, has the objective of improving the retention of navymen. The current emphasis is threefold: (a) development of procedures for assessing the effectiveness of Navy career counseling materials (e.g., film and slide packages); (b) development of methods for determining the impact of division officers and career counselors on reenlistment behavior; (c) development of a system for determining Navy wives' information needs vis-a-vis their husbands' career decisions. Results of this research are being used by the Bureau of Naval Personnel in planning new programs to increase the retention of Navy personnel. Funding: BUPERS

PERSONNEL AND TRAINING RESEARCH PROGRAMS

NR 156-046X MORE EFFECTIVE USE OF WOMEN IN THE ALL VOLUNTEER NAVY
University City Science Center/Day

The numbers of women in the Navy have increased significantly, as have career opportunities for women in previously all-male specialties. The research focuses on status relationships between men and women, with particular emphasis on male-female role factors influencing leadership behavior. A second interest is in factors in male versus female career motivation. Experiments will be used to assess the effects of sex-related variables upon task performance. Special observational techniques, including new evaluation methods, are being developed. Funding: ONR

NR 156-047 JOB EFFECTIVENESS OF ENLISTED PERSONNEL OF DIFFERENT MENTAL ABILITIES
Human Resources Research Organization/Vineberg

This work is aimed at providing valuable information about the job effectiveness and task flexibility of enlisted personnel of different mental-ability levels. The objective of this initial phase is to develop an instrument for evaluating individual performance in relation to each of the relevant properties of a Navy job. Items for evaluating performance will be prepared for each of the job elements of two Navy ratings, and incumbents' supervisors will complete the trial forms by an interactive procedure until a final version is achieved. This assessment instrument will parallel a Position Analysis Questionnaire (PAQ) developed previously under ONR sponsorship. (The PAQ is a job-analysis instrument that generates a profile describing a job in terms of its statistically-derived underlying dimensions.) The proposed instrument will provide measures of job proficiency along similarly derived underlying dimensions thus generating performance profiles congruent with the job-dimension profiles of the PAQ. The performance-measurement instrument will be applied to personnel of different mental abilities in a variety of Navy ratings. The result will be a catalog of information about those job dimensions that are associated with effective performance by individuals in lower mental categories. Funding: ONR, CNET

NR 156-048X ECONOMETRIC ANALYSIS OF MANPOWER ENLISTMENTS
General Research Corporation/Grissmer

The work began during FY 75 as an effort to develop an econometric model for measuring military pay elasticity under no-draft conditions. (Elasticity expresses the percentage change in enlistments for a given percentage change in enlistments for a given percentage change in pay, e.g. an elasticity of 2 means that a 10% increase in pay would raise enlistments by 20%.) The need for this research stems from the plethora of studies which show different elasticities. Several time-series and cross-sectional models are in use, and the present study will test their predictive or forecasting accuracy. The work will also test the contributions of other factors to enlistment behavior, e.g. unemployment rates, recruiting techniques, and expenditures. It is anticipated that Navy manpower policy planning and budget allocation will benefit from the ability to measure more effectively various enlistment incentives; in turn, this new capability will make possible better justification of manpower expenditures. The approach involves three facets: (a) a comparison of different forecasting models, (b) the comparison of

PERSONNEL AND TRAINING RESEARCH PROGRAMS

elasticities from different cross-sectional models (i.e., using data from the same year), and (c) the analysis of results from a pooled time-series model. Funding: ONR

NR 156-050X CHARACTERISTICS OF FILIPINO SAILORS RELEVANT TO PERSONNEL
MANAGEMENT AND TRAINING
American Institutes for Research/Szalay

Although they constitute the second largest minority group in the Navy, Filipinos are little understood from a cross-cultural point of view. The research measures the perceptions, attitudes, and psychocultural dispositions of Filipino navymen in order to better understand how Navy experience affects them. Findings will be incorporated into human resources management training programs, particularly into those elements dealing with minority group members. Funding: ONR, BUPERS

NR 156-051 FUTURE PERFORMANCE TREND INDICATORS: A CURRENT VALUE
APPROACH TO HUMAN RESOURCES ACCOUNTING
University of Michigan/Bowers

The Navy and Marine Corps, like other large organizations, need information systems which will allow them to assess the impact that current management practices are likely to have on future effectiveness of the organization. The attempts to gather and compile this information are known as Human Resources Accounting. This research is concerned with building up a methodology to accomplish Human Resources Accounting in the context of a Present Value approach, i.e., an approach involving estimating the future productive potential of today's human resources. Funding: ONR

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS (CODE 452)

Dr. John A. Nagay, Director	692-4502
Dr. Bert T. King, Associate Director	692-4503
Miss Cathy L. Alexander, Secretary	692-4502

These programs strive to enhance the performance of Naval crews, teams, and other groups by contributing to the development of principles governing interactions between and among people. These range from informal face-to-face encounters between individuals up to formal interactions between large organizations. The research promotes better understanding of the ways interactions develop and the effectiveness of human interactions as viewed from an organizational perspective.

TASK AREA: Organizational Effectiveness

A large part of the research program focuses on characteristics of the individual. Research on leadership and on managerial development is typical of this area. Such research is concerned with finding out what determines how well an individual fits into a group and how his skills and abilities are used in the exercise of leadership. The balance of the program is concerned with intergroup interactions. Rivalry among ethnic groups in the Navy and Marine Corps is typical of the topics dealt with in this part of the program. The concern is to find out why these rivalries develop and to discover effective techniques for preventing them, if possible, or for dealing with them if preventive efforts fail. Along these lines, considerable research effort is devoted to developing principles and techniques for managing necessary changes so that they occur in an orderly and nondisruptive manner.

NR 170-032 MANPOWER RESEARCH AND ADVISORY SERVICES
 Smithsonian Institution/Sinaiko

This contract addresses scientific issues related to the overall research program of the Psychological Sciences Division with special emphasis on the Manpower R&D Program. Symposia, working groups, short-term research efforts (e.g., the preparation of a literature review in critical areas) and expert consulting and advisory services are provided. In the case of the Manpower R&D Program, liaison activities among USN and scientific groups to foster exchange of information, to define problems and to evaluate manpower programs dominate. Last year's activities included partial support of a national conference on computer-aided adaptive testing, a symposium on leadership research, consultation on visual tasks in aircraft, and the organization of a major symposium on a topic of significant interest to the Navy, i.e., alternatives to conventional survey methodology for the collection of attitudinal information. Two new programs have been added as recipients of Smithsonian support activity this year: decision support systems and system acquisition research. Funding: ONR

Sinaiko, H. W., & Broedling, L. A. (Eds.). Perspectives on attitude assessment: Surveys and their alternatives--proceedings of a conference (Tech. Rep. 2). Smithsonian Institution, August 1975.

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

NR 170-742 ORGANIZATIONAL CHARACTERISTICS AND PERSONNEL EFFECTIVENESS IN THE NAVY Texas Christian University/Sells

This research aims toward increased understanding of the ways that organizational, environmental, and individual variables interact to determine the effectiveness of USN and USMC groups and crews. The analysis involves determining what relationships exist between organizational variables (e.g., size, mission, etc.) and the effectiveness, health and job satisfaction of individuals and groups. In addition, comparisons are made across different types of organizations (e.g., Navy ship vs. commercial vessel; Navy shore installation vs. a comparable civilian organization). Sells is closely coordinating his research with that of Gunderson at the Naval Health Research Center (NR 170-743). Funding: ONR

James, L. R., Stebbins, M. W., Hartman, E. A., & Jones, A. P. An examination of the relationships between psychological climate and a VIE model for work motivation (IBR Tech. Rep. 74-29). Texas Christian University, March 1975. (AD A009 828)

James, L. R., Hartman, E. A., Jones, A. P., & Stebbins, M. W. An examination of job satisfaction dichotomies (IBR Tech. Rep. 74-30). Texas Christian University, April 1975. (AD A009 829)

Jones, A. P., James, L. R., & Bruni, J. R. Black-white differences in psychological climate and organizationally related attitudes aboard Navy ships (IBR Tech. Rep. 75-5). Texas Christian University, March 1975. (AD A009 827)

Bruni, J. R., Jones, A. P., & James, L. R. Correlates of first-term reenlistment behavior aboard Navy ships (IBR Tech. Rep. 75-8). Texas Christian University, May 1975. (AD A015 687)

NR 170-744 IMPROVING GROUP PERFORMANCE EFFECTIVENESS Yale University/Hackman

Lack of knowledge about the interaction of group-composition, group-task and group-process variables limits the accuracy of predictions of work effectiveness. This research provides a basis by means of which future technology may enhance the effectiveness of work groups. Hackman is examining two classes of variables that determine group effectiveness: (1) the type of task confronting the group; and (2) the process of group interaction. He is working on development of a suitable conceptualization of tasks and on corresponding analyses of group-process variables and the way they are influenced by the decisions and actions of group leaders. Funding: ONR

Frank, L. L., & Hackman, J. R. A failure of job enrichment: The case of the change that wasn't (Tech. Rep. 8). Yale University, March 1975. (AD A007 356)

Oldham, G. R., Hackman, J. R., & Pearce, J. Conditions under which employees respond positively to enriched work (Tech. Rep. 10). Yale University, September 1975. (AD A016 248)

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

NR 170-748 SOME VARIABLES THAT CONTROL SELECTIVE EXPOSURE TO INFORMATION
American University/McGinnies

Attempts to change attitudes toward service in the USN or toward USN minority groups require that people pay attention to the informative and persuasive communications that the USN directs at them. This research increases our knowledge of the conditions that determine which individuals in the audience "tune out" such persuasive communications and our knowledge of the incentives that could be used to elicit more favorable responses. Laboratory experiments include variation in the type and amount of information to which people are exposed. People with different histories of exposure to a particular content area in a given attitude area are given opportunities to attend selectively either to "pro" or "con" communication. The dependent variables include the degree to which people actually do attend to the communications and the amount of opinion change produced. Funding: ONR

Wellins, R. S., & McGinnies, E. Opportunity to counterargue and voluntary exposure to counterattitudinal message (Tech. Rep. 6-A). American University, May 1975.

Wellins, R. S., McGinnies, E., & Hamell, E. Some variables influencing counterarguing and selective exposure to a counterattitudinal message (Tech. Rep. 6-B). American University, August 1975. (AD A014 473)

McGinnies, E., Forbes, R. R., & Wellins, R. Token reinforcement and selective exposure to persuasion (Tech. Rep. 7). American University, September 1975. (AD A016 293)

NR 170-755 IDENTIFICATION AND DEVELOPMENT OF GENERAL MANAGERS
Stanford University/Harrell

This research aims to build a foundation for identifying those individuals who are most likely to succeed as general managers. It involves the use of psychological tests, vocational preference inventories, and selected background characteristics in a longitudinal study of personnel, including some USN officers, who attended post-graduate management school a decade ago. Data collected then are being analyzed to determine which factors appear to be predictive of early attainment of general management status. This research will yield a set of indicators which could be used to select managers with the highest probability of eventual success at higher echelons. Funding: ONR

Bonini, C. P. Computers, modeling and management education (Tech. Rep. 6). Stanford University, May 1975. (AD A009 832)

Harrell, T. W., & Harrell, M. S. A scale for high earners (Tech. Rep. 7). Stanford University, July 1975. (AD A012 396)

Harrell, T. W., & Harrell, M. S. Career paths to general management (Tech. Rep. 8). Stanford University, August 1975. (AD A014 471)

NR 170-762 ATTITUDINAL FACTORS IN ACCEPTANCE OF TECHNOLOGICAL INNOVATIONS
Navy Personnel Research and Development Center/Abrams

The objective of this research is to devise, and evaluate the effectiveness of, organizational development procedures designed to promote the

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

ready acceptance of new weapons systems. It includes controlled experiments, case histories and field observations. Change advocates are designated in the sonar teams aboard submarines and their role is defined in a series of experiments. Their experiences in introducing new equipment will be observed. Funding: ONR

Abrams, A. J., Sheposh, J. P., & Licht, M. H. The use of evidence in influencing technician attitudes (Tech. Rep. 76-10). Navy Personnel Research and Development Center, September 1975. (AD A017 602)

NR 170-763 MODELS OF GROUP COMMUNICATION STRUCTURE IN LARGE ORGANIZATIONS
California State University, San Jose/Monge

This research provides a foundation for the improvement of future Navy interpersonal communications. It involves the identification of the actual human communication networks in various organizational settings, comparing these with the formal organizational structure that exists in the organization's and identifying variables such as proximity, connectedness, centrality, and integration that account for the actual communication structure as it exists. Static and dynamic models of the causal antecedents of communication structure have been developed. Data for the research have been collected from personnel at the Treasure Island Naval Station. To the extent that this effort succeeds, it will permit the prediction of the effectiveness of a communication network or the modification of it in ways that enhance organizational effectiveness. Funding: ONR

Monge, P. R., & Kirste, K. K. Proximity: Location, time and opportunity to communicate (Tech. Rep. 3). California State University, March 1975. (AD A011 151)

NR 170-767 INDIVIDUAL, GROUP AND ORGANIZATIONAL DETERMINANTS OF THE EFFECTIVENESS OF LEADERSHIP TRAINING AND ASSIGNMENT PROCEDURES
University of Washington/Fiedler

Fiedler's contingency theory of leadership has exerted a profound influence on the direction of current research in leadership and management. Much of the success of the contingency theory can be attributed to its departure from earlier theories which viewed leadership effectiveness in terms of one's possession of specific traits. In contrast, Fiedler bases leader behavior on the dynamic relationships among four core factors: (1) the motivational style of the leader (task-motivated vs. relations-motivated); (2) task structure; (3) power of the leader; and (4) situation favorability or unfavorability. Over the years Fiedler has conducted extensive research which has clarified the manner in which the forces, described above, combine to determine the success of a leader. He has recently extended his model to the leadership training situation through the preparation of a programmed workbook which sensitizes leaders to their own motivational style and its impact upon subordinates and group productivity. This product is currently under experimental tryout in a variety of industrial and military settings. Funding: ONR, ARPA

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

Bons, P. M., & Fiedler, F. E. The effect of changes in command environment on the behavior of relationship- and task-motivated leaders (Tech. Rep. 75-63). University of Washington, January 1975.

Gochman, I., & Fiedler, F. E. The effect of situational favorableness on leader and member perceptions of leader behavior (Tech. Rep. 75-64). University of Washington, April 1975.

Fiedler, F. E., Mahar, L., & Schmidt, D. Two validation studies of contingency model training: Leader match (Tech. Rep. 75-70 and 75-73). University of Washington, December 1975.

NR 170-768 DESCRIPTIVE AND NORMATIVE MODELS OF DECISION-MAKING IN
ORGANIZATIONAL CONTEXTS
Yale University/Vroom

This research aims at increased understanding of the leadership process in organizations and at the eventual development of technologies for translating such knowledge into procedures and materials for the assessment and training of future USN and USMC leaders. It involves constructing a descriptive model of decisions made by leaders in organizational contexts and a normative model of the procedures managers should use in personnel decision-making. These decision-making models incorporate variables like the leader's position in the hierarchy, his values concerning participation by subordinates, his functional area of work and the overall organizational climate. Funding: ONR

Jago, A. G., & Vroom, V. H. Hierarchical level and leadership style: On the resolution of a contradiction (Tech. Rep. 8). Yale University, August 1975. (AD A013 353)

NR 170-771 THE ASSESSMENT OF INTERRACIAL TENSION IN THE U.S. NAVY
Howard University/Bayton

In spite of official policies to eradicate racial discrimination within the USN and USMC, interracial friction, based on perceived inequities in the system, still persist. Voluntary isolation of ethnic groups is still a way of life. Racially motivated confrontation frequently erupts into overt disruptive behavior without forewarning. Clearly, what is required is a sensitive and systematic method of assessing tension in an organization so that ameliorative measures can be applied to avert open hostility. The current research deals with this problem and offers promise of the development of an effective technology. The Principal Investigator is designing and testing a psychosocial model which can be used to measure existing and potential tension. The model will describe the manner in which specified factors (psychological and social) combine to influence the probability of confrontation behavior. The work is in its final phase. Data are currently being collected at Naval installations. Funding: ONR

NR 170-784 THE RELATIONSHIP BETWEEN RACIAL ATTITUDES AND HELPING
BEHAVIOR
University of Delaware/Gaertner

The complaints of minority personnel in the Navy center around alleged inequitable treatment in assignment, promotion, and judicial, as well as non-judicial punishment. Though significant advances have been made by

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

Navy leadership to eliminate personal and institutional discrimination, there is yet ample opportunity for personal prejudice to influence the implementation of new policies. Employing both field and laboratory studies, Dr. Gaertner's research is attempting to elucidate the area of personal prejudice by examining the mechanisms involved in differential interpretation of "emergency situations" as dependent upon the race of the "victim." The research will provide top-level management with a deeper understanding of some of the reasons for the disparity between official policy and its enactment. Funding: ONR

NR 170-785 TECHNOLOGY FOR GROUP ESTIMATION PROCEDURES IN FORECASTING
AND DECISION MAKING
University of California, Los Angeles/Rubinstein & Dalkey

Strategic and tactical planning, as well as military management in general, require reliable, accurate procedures for estimating the future status of parameters. This research will provide an improved technology for use in group estimation of parameters involved in forecasting and decision studies. It will involve the preparation of a handbook of group judgment (Delphi) techniques--a compendium of theoretical and experimental results achieved to date, with derived procedures appropriate for applications of Delphi to forecasting and decision studies. The work has been completed and is being prepared for publication. Funding: ARPA, ONR

Dalkey, N. C. Group decision analysis (Interim Tech. Rep.). University of California, August 1975. (AD A016 273)

NR 170-790 CLUSTERING DURING WORK AND LEISURE
Minnesota Systems Research, Inc./Sykes

The era of an All Volunteer Force has been characterized by significant increases in the percentage of minority group personnel in the military. Experienced observers of group behavior report that, in spite of apparent quiescence, there is currently a high level of racial polarization among Navy crews. Given a precipitating event such polarization can readily be transformed to overt hostility. This research responds to the need for a mechanism capable of promoting cooperation and harmony among work crews. It involves the study of the processes involved in the formation of "informal" groups and the determination of the extent to which such networks can be influenced to embrace ethnically heterogeneous groupings. In a series of field experimental and observational studies, the living space for Navy trainees will be rearranged in such a way as to set up a gradient of possible interactional patterns among personnel differing in ethnic background. The gradient will vary from minimal to maximal opportunity for interaction. Additionally, the training format of selected aspects of the curriculum will be manipulated to encourage team performance versus individual performance. To the extent possible each team will be ethnically heterogeneous. The criterion of success will be based on group rather than individual proficiency. By means of a specially designed recording apparatus, data on the patterns of informal groups that emerge as a function of the experimental manipulations will be obtained. The bulk of the effort to date has been devoted to the selection of an appropriate site for the research in which the planned experimental variations can be introduced with minimal interference with training objectives. Data are now being collected. Funding: ONR, CNET

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

NR 170-793 DATA ACCURACY IN SOCIAL NETWORK ANALYSIS
West Virginia University/Bernard & Killworth

One of the most persistent needs in the study of complex organizations is for improved criteria of organizational effectiveness. One promising method involves analyses of the human communication networks. This task, aimed at this general goal, is proceeding towards the development of a quantitative theory of group dynamics and the development of models of dynamic social networks. A more immediate goal is the specification of the error bounds of the data which comprise the human inputs to social network analyses. The approach involves development and refinement of a model of dynamic social networks through tests involving data from various groups; e.g., prisons, research vessels, units in naval training, etc. Research aimed at determining the error bounds of the data collection methods employed involves monitoring the communication patterns of naturally-occurring groups where objective records of communications are available. The principal accomplishment of the research thus far has been the development of a method called "CATIJ" which describes the structure of communications networks in complex organizations up to 150 in size. A computer program to aid in such analyses has been produced.
Funding: ONR

Bernard, H. R., & Killworth, P. D. Some formal properties of networks (Tech. Rep. BK-105-75). West Virginia University, January 1975. (AD A003 076)

Bernard, H. R., & Killworth, P. D. On the structure of affective and effective sociometric relations in a closed group over time (Tech. Rep. BK-107-75). West Virginia University, March 1975. (AD A006 976)

Killworth, P. D., & Bernard, H. R. How to use the KBPAK (Interim Rep.) West Virginia University, March 1975. (AD A007 349)

Killworth, P. D., & Bernard, H. R. A model of human group dynamics (Tech. Rep. BK-108-75). West Virginia University, April 1975. (AD A008 430)

Bernard, H. R., & Killworth, P. D. KBDATA--a bank of effective sociometric data sets (Tech. Rep. BK-109-75). West Virginia University, June 1975. (AD A010 887)

Killworth, P. D., & Bernard, H. R. Informant accuracy in social network data (Tech. Rep. BK-110-75). West Virginia University, June 1975. (AD A011 362)

Bernard, H. R., & Killworth, P. D. Deterministic models of social networks (Tech. Rep. BK-111-75). West Virginia University, September 1975. (AD A014 968)

NR 170-794 BEHAVIORAL RESEARCH ON DECISION PROCESSES IN ORGANIZATIONAL AND BUREAUCRATIC CONTENTS
University of California, Los Angeles/Shure

This work unit involves research designed to improve the technology base for defense decision-making with respect to threat assessment, military alliances, and force deployment at the Center for Computer Based Behavioral Studies (CCBS) that has been established at UCLA with ARPA funding. Various methodologies are used in an attempt to elucidate the

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

psychological, social, and political science processes involved in defense decision-making: small group laboratory experiments, simulations of political-military organizations, the use of a utility model in arms negotiations, and automated content analysis. Emphasis is placed on the unique capabilities of CCBS which include laboratory facilities for: man-machine system design; multi-team laboratory experiments; gaming; simulation and associated training; and interactive data management and analysis. CCBS, with its interactive computer system, is used to help manage research, retrieve information, analyze data, and to aid both researchers and officials to make better decisions. A number of studies and experiments on multi-issue negotiation and bureaucratic bargaining are at various stages of completion. A computerized text management system has become operational. Funding: ARPA

NR 170-797 FACTORS INFLUENCING THE PERFORMANCE OF COOPERATIVE GROUPS University of Florida/Schlenker

This research aims at increasing our understanding of the factors that enhance or degrade the performance of small groups (such as Navy or Marine Corps crews and teams) where closely coordinated cooperative action is required. Its particular focus is on how group members perceive their own responsibility for the past successes or failures of the group, a phenomenon called "egocentric attribution." Laboratory experiments are presently being conducted to test hypotheses relating to the interactions between attribution processes and other variables such as the importance of the task, cohesiveness of the group, amount of individual responsibility for group output, and perceptions of equity by group members. Funding: ONR

Schlenker, Barry R. & Forsyth, Donelson R. Attributing the causes of group performance: Effects of performance quality, task importance, and future testing (Tech. Rep. 75-1). University of Florida, December 1, 1975.

Schlenker, Barry R., et al. Group cohesiveness as a determinant of egocentric perceptions in cooperative groups (Tech. Rep. 75-2). University of Florida, December 1, 1975.

NR 170-799 RACIAL DIFFERENCES IN GROUP INTERACTION IN LABORATORY AND FIELD SETTINGS University of North Carolina, Charlotte/Ruhe

The ongoing Navy program to increase the number of recruits from minority groups will obviously result in a higher incidence of racially mixed work groups. In an effort to understand the manner by which individuals from different cultures interact with each other and with their work group supervisors, this research is exploring some of the differences between black and white supervised racially heterogeneous subordinate groups in both Navy and university settings. Thus far, no substantial differences in the leadership performance of black and white supervisors has been found. Subordinates from the two ethnic groups preferred leaders of their own group. Leader, group, and interaction effects were found between leaders and group types. Funding: ONR

Allen, W. R., & Ruhe, J. A. Attitude differences and task performance for black and white naval recruits in problem-solving groups of differing size and racial composition (Tech. Rep. 75-1). University of North Carolina, October 1975. (AD A016 832)

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

NR 170-801 CONCEPTUAL FRAMEWORK FOR RESEARCH ON ORGANIZATIONAL
EFFECTIVENESS
Carnegie-Mellon University/Goodman

Navy programs to improve the quality of working life are limited by inadequate knowledge as to how different indices of organizational effectiveness (e.g., productivity, accidents, satisfaction) relate to each other and to organizational input factors. This research will improve the relevant technology base by developing a framework of organizational effectiveness. The investigators have used as their point of departure a recent Navy-sponsored review of the organizational literature which revealed a dearth of systematic attempts to define organizational effectiveness theoretically or operationally. In order to reduce this knowledge gap, the investigators are doing the following: (a) identifying major conceptual issues underlying the construct of organizational effectiveness; (b) developing a conceptual framework for systematic study of the determinants of organizational effectiveness which attempts to integrate expectancy theory and structural contingency theory approaches; and (c) examining the implications of this conceptual framework for future research on organizational effectiveness in the Navy and in other organizations. Funding: ONR

NR 170-802 THE EFFECTS OF ORGANIZATIONAL STRUCTURE AND DEMOGRAPHIC
CHARACTERISTICS ON WORK
University of Illinois/Hulin

While a number of current experiments and action programs involve restructuring or relocating Navy offices and functions, it is not now feasible to make precise predictions of the effects of such changes on work performance and job satisfaction. The present work unit is designed to provide an improved foundation for such predictions by developing appropriate models and measurement instruments and by conducting relevant field studies and experiments. This research involves an iterative process in which organizational model-building and data collection efforts alternate. The model which is being constructed specifies that certain variables (work values, perceived similarities among jobs, organizational climate, informal communication) moderate the relationships among the organizational structure, the demographic characteristics of the workers, and the standard output variables. Instruments are constructed (or revised) to measure the specified variables. Tests are conducted in various organizations to determine how effective the model is in predicting the results of management-induced changes in either the organizational structure or in the physical environment of the organization. Funding: ONR

NR 170-803 DYNAMICS OF MINORITY GROUPS
Harvard University/Pierce

The small group research upon which current theories of group dynamics are based has neglected, to a large extent, to consider the effects of ethnic variables upon group performance. This research seeks to extend group dynamics theory by including the consideration of factors which impinge upon group effectiveness when groups include minority members, particularly when minority members come from stressful (e.g., "inner-city") environments. In addition to the theoretical contributions which are expected, the development of strategems for promoting cooperative behavior in racially-mixed groups is an anticipated byproduct which

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

should prove useful to Navy and Marine Corps leaders/managers. Theory building will proceed through a series of experiments involving group problem solving by racially mixed groups. Thirty such groups of about 15 members each will be given problem solving tasks and their interactions video-taped. Speed of problem resolution, range of options considered, use of long vs. short-range perspectives, deference patterns, defeatism, dissension, and aggression are among the kinds of variables which will be analyzed and related to the ethnic composition of the groups. Funding: ONR

NR 170-804 EFFECTS OF LIFE STRESS AND COPING SKILLS ON PERFORMANCE
AND ORGANIZATIONAL EFFECTIVENESS
University of Washington/Sarason

In training personnel who will later be exposed to high levels of stress (e.g., aviators, submariners, UDT personnel), the Navy is limited by gaps in our knowledge of the fundamental relationships among situational stressors, life stress, individuals' coping skills, and organizational contexts. This work unit is designed to clarify these relationships and experiment with various individual and organizational procedures for improving the ability to cope with stress in organizational contexts. Earlier research has demonstrated that stress is associated with morbidity and with decreased performance in certain kinds of situations. This research will produce new measures designed to assess organizational stress. The investigator is experimenting with various techniques for altering cognitive responses, since these are thought to be involved in mediating the deleterious effects of stress on performance. The initial experiments in civilian groups exposed to high levels of job stress, will if successful, be extended to military groups working under high stress conditions. Funding: ONR

NR 170-805 DECISION PROCESS MODELS OF PEER NOMINATIONS FOR PREDICTION
OF FUTURE PERFORMANCE
Duke University/Lewin

This research is aimed at the derivation of a theory which will explain the behavior of individuals when they are involved in rating the performance of their peers. It also aims at predicting their peer rating behavior. The Navy and other military services have found peer ratings to be quite useful in certain aspects of personnel research and operations, but little is known about the human judgmental process involved in making such evaluations. This research seeks to fill this knowledge gap and will also address certain practical problems associated with the use of the peer rating technique. Cognitive decision-process modelling will be employed for the development of an empirically-grounded theory of interpersonal judgment, specifically peer nominations. Such models will be derived from protocol and interview data and will take the form of computer programs. Quantitative inputs to the models will be provided from behavioral scores obtained from observations of individuals engaged in an experiment involving a group decision-making task. The models will be validated against independent peer ratings obtained from a control group and against the subsequent performance of the participants in the experiment. Funding: ONR

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

NR 170-807 LEADERSHIP EFFECTIVENESS: CULTURAL AND COGNITIVE CORRELATES
Systems and Evaluations/Ramirez & Castaneda

Recent developments in the fields of psychology and education have drawn attention to the concept of "cognitive styles." The concept refers to individual differences in preferred modes of processing information, or organizing, classifying, and assimilating the environment. A basic assumption of this research is that a conscious, articulated awareness of the cultural characteristics of cognitive styles can serve as the base for developing more effective leadership training, enhancing organizational effectiveness and for the guiding of group dynamics in the area of cooperative behavior. Its major thrust is to explore strategies for developing leaders' awareness of the characteristics associated with two major cognitive styles: field independence and field dependence. Instrumentation for identifying dimensions of biculturalism will be developed through life history assessments and analyses of other psychological measures. From these data, bicultural profiles and cognitive styles will be devised. Funding: ONR

NR 170-808 DECISIONS UNDER CONDITIONS OF UNCERTAINTY
University of Washington/Mitchell & Beach

This research is aimed at determining the effects of uncertainty upon decision making, upon decision effectiveness and satisfaction, and with the development of methods for dealing with the problems created by uncertainty. The approach involves a series of laboratory experiments which test hypotheses drawn from a general theory of uncertainty and manipulation of classes of variables relating to: (1) information reception and uncertainty; (2) characteristics of the decision task; (3) the information; (4) the information source; (5) the decision maker; and group or organizational influences on uncertainty. The final effort will be an attempt to develop decision aids to assist decision makers in understanding and coping with uncertainty. Funding: ONR

NR 170-809 CRITERIA FOR ATTITUDE/BEHAVIOR CHANGE
Human Sciences Research, Inc./Nordlie

Navy organizations which employ more than 300,000 civilian personnel use a number of different training approaches to the realization of equal employment opportunity goals. Little is known, however, about the impact of these programs (generally called "human relations training"). This research effort is aimed at the development of a multi-faceted criterion system which will measure reliably the extent to which such training meets its objectives at the individual, interpersonal, and institutional levels. The approach involves the development of a comprehensive set of training program objectives through analysis of Navy policies, directives, curricula, etc., and a survey of appropriate Navy personnel; the development of means for measuring the dimensions revealed; and, the planning and execution of research which will permit the comparative assessment of several ongoing training programs. The work has progressed through the development and pretesting of criterion instruments. Funding: ONR

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

NR 170-812 INCREASING PERSONNEL RETENTION AND ORGANIZATIONAL COMMITMENT
University of Oregon/Steers

Military personnel retention and attrition are hypothesized to be a function of the degree of commitment or attachment the individual experiences with respect to the military organization. This research is designed to discover what individual, task, and organizational factors determine the level of organizational commitment and how it can be increased. In general, the approach involves measuring the impact of independent variables (like expectations of receiving various kinds of incentives and perceptions of the extent to which the organization provides opportunities for satisfying the individual's needs) on commitment to the organization, absenteeism, job performance, and personnel retention. The research design includes longitudinal studies (measuring performance of a group or groups over time), field experiments, personnel surveys, and observation techniques. Several different geographical locations and organizational contexts are being used in order to increase the generalizability of the findings. Funding: ONR

Steers, R. M. Problems in the measurement of organizational effectiveness (Tech. Rep.). University of Oregon, November 1975.

NATIONAL SECURITY CRISIS MANAGEMENT

The following nine contracts represent that part of the Defense Advanced Research Projects Agency's program on national security crisis management that is monitored by ONR. The general goal of this program is to increase the effectiveness of crisis decision making. More specifically, the program aims at the development of short- and long-term crisis forecasting techniques, models for estimating the impact of international events upon the military postures and decisions of nations, and optimal organizational arrangements for managing crises.

NR 170-773 THREAT PROCESSES RECOGNITION AND ANALYSIS
University of Southern California, Los Angeles/McClelland

This work is an attempt to "bridge the gap" between research done in an academic setting and the practical needs of military strategic planners and analysts. It is aimed at the improvement of techniques for the recognition of international threat (i.e., the rapid recognition of dangerous situations in early developmental stages and methods of identifying optimal corrective actions through better understanding of threat processes. The approach involves the development of new, different, improved, or more relevant concepts, models, and insights into the recognition and analysis of international military and non-military threats. Following such analyses, new methodologies for the monitoring and analysis of threats; e.g., analytical routines, procedures of inquiry, and operational recommendations will be attempted. An extensive survey of the literature on threat has been completed. Considerable effort has also gone into an attempt to develop a "controlled" definition of threat; i.e., to enable its differentiation from other forms of international behavior. A preliminary model of international commitment and its linkage to threat has been developed. Methods for the monitoring of international event-interactions developed under this research are to be incorporated in a prototype early crisis warning system under development by another contractor. Funding: ARPA

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

- McGowan, P. J. Threat recognition and analysis project Southern African sybssystem study (SASS) (Tech. Rep. 19). University of Southern California, January 1975. (AD A005 328)
- Glaser, T. T. Country threat file codebook (Tech. Rep. 20). University of Southern California, January 1975. (AD A005 329)
- McGowan, P. J., & Shaw, T. M. Search codes for a bibliography for the study of African international relations (Tech. Rep. 21). University of Southern California, January 1975. (AD A005 351)
- Martin, W. R. International military commitment: A conceptual definition (Tech. Rep. 22). University of Southern California, January 1975. (AD A005 352)
- Beal, R. S. Crises in a transforming international system (Tech. Rep. 24). University of Southern California, January 1975. (AD A005 353)
- Beal, R. S. Phases of a crisis (Tech. Rep. 25). University of Southern California, January 1975. (AD A005 354)
- Beal, R. S. Monitoring international crises (Tech. Rep. 26). University of Southern California, January 1975. (AD A005 355)
- Hill, F. A. Semi-annual technical report (Tech. Rep. 27). University of Southern California, January 1975. (AD A005 356)
- Hill, G. A. Resource diplomacy: The role of natural resources in international politics (Tech. Rep. 23). University of Southern California, May 1975. (AD A010 533)
- McClelland, C. A. Crisis and threat in the international setting: Some relational concepts (Tech. Rep. 28). University of Southern California, June 1975. (AD A011 913)
- Martin, W. R. International military commitment indicators: Operational definitions (Tech. Rep.). University of Southern California, July 1975. (AD A013 126)
- McClelland, C. A. Defense against threat: Annual report of the threat recognition and analysis project (Tech. Rep. 30). University of Southern California, September 1975.

NR 170-777 INTERNATIONAL BEHAVIOR ANALYSIS: THE COMPONENT APPROACH
University of Maryland/Wilkenfeld

The International Behavior Analysis (IBA) Project is a long range research project designed to provide explanatory and predictive insight into the actions and interactions of nations. More specifically, the project is designed to explain and predict how, why, and when certain nations are likely to act in response to certain sets of internal (domestic) and external (foreign) stimuli. It was decided early in the conceptual stages of the IBA Project to construct an overarching analytical framework to enable the organization and integration of the endless number of factors of variables to be considered in the analysis of international behavior. The framework consists of three sets of factors: (1) the variables (organized into clusters, or components) which give rise or respond to certain international events; (2) a typology of international actors

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

(nations) to facilitate the comparative analysis of international behavior, based upon a large number of national attributes, clustered into economic, governmental, and capability dimensions, has been constructed and operationalized; and (3) a typology of international events to facilitate sources and process analyses. The framework has been completed and data are being collected for the typologies that have been constructed.
Funding: ARPA

Wilkenfeld, J., & Andriole, S. J. The sources and processes of international behavior (Semi-Annual Tech. Rep.). University of Maryland, March 1975. (AD A007 576)

Andriole, S. J. International behavior: An overarching framework for analysis (Semi-Annual Tech. Rep.). University of Maryland, September 1975.

Hopple, G. W. International behavior analysis: The operationalization task (Semi-Annual Tech. Rep.). University of Maryland, January 1976.

NR 170-781 EXPLORATIONS IN THE MANAGEMENT OF INTERNATIONAL CRISIS
Ohio State University/Hermann

The objectives of this research include: (1) the identification of priority research tasks for international crisis avoidance and management, (2) the development of a multi-causal model of international crisis behavior, (3) the development of a set of indicators of stress experienced by individuals in crisis situations, and (4) the identification of organizational variables which can impact upon the effectiveness of crisis management and a survey of existing simulation techniques for their potential utility in determining the effects of alternative organizational arrangements. The first objective has been met through the medium of a workshop which brought together a small group of scholars to consider research needs in the area of international crisis management. Completion of the balance of the research is anticipated by August 1976. Funding: ARPA

Hermann, C. F. Research tasks for international crisis avoidance and management (Final Rep. 3995-A1). Ohio State University, October 1975.

NR 170-782 MILITARY FORCE AS A POLITICAL INSTRUMENT SINCE WORLD WAR II: POLICY IMPLICATIONS
The Brookings Institution/Blechman

This research is examining the ways, and the effectiveness with which, the United States and the Soviet Union have employed their armed forces, short of actual violence, during the period 1946-1975. The study is designed to illustrate the interconnections between military force and the success or failure of foreign policy in the postwar period. As the threat of direct conflict between the superpowers has receded, the consequences of changes in the size and character of military inventories, the deployment of military units, and the use of military force for demonstrative purposes, have attained new prominence. This study -- founded on empirical analysis of the perhaps 300 incidents since 1945 in which either the United States or the USSR has utilized its armed forces, without significant violence, in support of foreign policy objectives -- is intended to address the effectiveness of military force in this role to draw implications for U.S. foreign policy and the structure of U.S. military force. Funding: ARPA

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

Blechman, B. M., & Kaplan, S. S. Military force as a political instrument since the Second World War: Policy implications (Tech. Rep. 1). The Brookings Institution, August 1975. (AD A014 656)

NR 170-783 ORGANIZATIONAL COMMUNICATION AND DECISION-MAKING IN CRISIS
Ohio State University/Dynes & Quarantelli

This research will develop and test a model of organizational behavior in crisis situations and assess its generalizability and relevance for international crisis management. Utilizing an extensive data base comprised of intensive field studies of disasters and emergency planning operations conducted by the Disaster Research Center of Ohio State University, a series of propositions are being derived about organizational communication and decision making in crises. From these, a model of organizational crisis behavior is being developed and its generalizability to other kinds of crises (e.g., military) will be determined. Finally, implications will be drawn for planning more effective crisis management in general. Funding: ARPA

NR 170-795 PLANNING FOR PROBLEMS IN CRISIS MANAGEMENT
CACI, Inc./Hazelwood

This research is a follow-on to earlier work which demonstrated that historical information on crises can be used to identify similarities and differences in crisis characteristics. Since it is extremely difficult to anticipate correctly the specific characteristics of crisis situations (the element of surprise forms part of the definition of the term) historical information about the problems encountered in the management of past crises can be useful in crisis management planning. This work will expand a historical inventory of crises produced earlier; will identify and collect information on problems encountered by the United States in crisis management and identify patterning, or clusters, of crisis management problems; and illustrate the use of such information in crisis management planning. Funding: ARPA

Moore, J. A. Crisis inventory. CACI, Inc., August 1975. (AD A015 721)

NR 170-798 CRISIS WARNING AND MANAGEMENT
University of Maryland/Bobrow

Those individuals and groups within DoD who deal with national security policy are periodically confronted with international crises which impinge on the U.S. after they have escalated into serious confrontations. This research is aimed at three improvements in our capability to deal with such situations: (a) better early warning indicators of impending crises, (b) better ways to anticipate when force will be used to resolve such crises, and (c) an improved ability to communicate so as to increase the odds for crisis-avoidance or resolution. The approach involves: (a) the selection of nations for case study; (b) the review and adaptation of event-interaction and national attribute data sets generated by other Government-supported projects relevant to the purposes of this research, and (c) the development and testing of a coding technique for the data of the project. In addition, technical and advisory services are provided to ARPA aimed at the integration of the several facets of the

ORGANIZATIONAL EFFECTIVENESS RESEARCH PROGRAMS

ongoing research program. The principal investigator submitted a program perspective document to ARPA on the requisite activities involved in planning and coordinating the ARPA crisis management program, reviewed available data sets on the People's Republic of China, and began a content analysis. Funding: ARPA

NR 170-816 A STUDY OF AD HOC VERSUS ESTABLISHED PROCEDURES AND GROUPS
 IN CRISIS MANAGEMENT
 Human Sciences Research, Inc./Havron

There is evidence from psychological and sociological research which suggests that when the various tasks of crisis management are handled in an ad hoc manner, the effectiveness of the process is decreased. This research will investigate this question in the context of crisis management in the Department of Defense (DoD). Two propositions will be examined: (a) crisis management in the DoD is in large part handled through ad hoc procedures and/or by ad hoc groups; and (b) the effectiveness of crisis management by ad hoc procedures and groups is inferior to that of established or regularized procedures and groups. Evidence relating to the propositions to be investigated will be gleaned from existing research literature on crisis decision making, organization theory, and relevant sources from the psychological and sociological literature. The applicability of the findings to the real world of DoD crisis management will be assessed through soliciting the judgments of experts in this area. Funding: ARPA

NR 170-818 MANPOWER, TECHNOLOGY AND THE CONSEQUENCES OF MILITARY
 INTERVENTION
 Loyola University/Sarkesian

This effort involves the organization of a planning conference to be followed by a full-scale international research conference on the changing role of the military in international relations. The conference is aimed at clarifying the impact of a number of factors upon the use of military force in international relations. It will explore factors not usually considered by social scientists in their assessment of the impact of social and political changes on military strategy and posture; i.e., changes in manpower policies and practices (the all volunteer force in the U.S. and similar drastic changes within the NATO countries) and particularly the impact of changing military technology. An interdisciplinary group of scholars will be invited to present research papers. Funding: ARPA

ENGINEERING PSYCHOLOGY PROGRAMS (CODE 455)

Dr. Martin A. Tolcott, Director	692-4506
Mr. Gerald S. Malecki, Assistant Director	692-4505
Dr. John J. O'Hare, Psychologist	692-4507
Mrs. Evelyn Graham, Secretary	692-4507

The Engineering Psychology Programs are concerned with investigating technological factors which may increase the effectiveness of human performance in systems involving humans and machines, and with deriving new principles and techniques for improving systems design. The programs are carried under a 6.1 project, "Engineering Psychology", and a 6.3 project, "Operational Decision Aids".

The Engineering Psychology Project is composed of two Task Areas, viz., "Human Engineering" and "Performance Effectiveness".

TASK AREA: Human Engineering

Human Engineering focuses directly on the interface between humans and machines, including controls, displays, workplaces, environments, communication links, protective devices, and job aids. Areas of specific concern include aircraft instrumentation and control, sensor displays, computer-aiding of performance, shipboard habitability and underwater systems. The objective is the development of principles, guidelines, techniques and procedures to achieve improved design of Navy and Marine Corps man-machine systems.

NR 196-128 ADAPTIVE COMPUTER AIDING IN DYNAMIC DECISION PROCESSES
Perceptronics, Inc./Freedy

This research addresses the improvement of human decision making through adaptive computer aiding systems. Such systems monitor human decisions and the conditions under which they are made, infer the nature of the changing environment and the outcome preferences (or utilities) of the decision maker, and gradually become capable of providing predictive information, recommending responses, or taking over control, as desired. The research utilizes a simulated intelligence-gathering task, in which observers deploy specialized sensors of differing sensitivity, reliability and cost, and make periodic estimates of the operational situation. Building upon previous results which permitted optimization of the utility-estimating algorithms and the information feedback methods, recent experiments have compared performance of aided and non-aided groups. Results showed that aided observers were more consistent, they performed closer to their own maximum expected utility, and completed more decisions per unit time. Funding: ARPA

Davis, K. B., Weisbrod, R. L., Freedy, A., & Weltman, G. Adaptive computer aiding in dynamic decision processes: An experimental study of aiding effectiveness (Tech. Rep. PTR-1016-75-5). Perceptronics, Inc. May 1, 1975. (AD A014 218)

ENGINEERING PSYCHOLOGY PROGRAMS

NR 196-130 SONAR DISPLAY RESEARCH Naval Undersea Center/Thomson

Computer-driven displays and their associated storage units permit a great degree of operator interaction which is especially useful when the amount and complexity of data available for presentation to the operator increases. A multi-mode display system with graphic, alphanumeric, and raster formats was utilized to study the effects of machine processing, display, and procedural variables on human perceptual and decision processes during sonar detection, localization, and classification. The dependence of probability of detection and tracking on the display parameters of bin width, bin height, time history, signal-to-noise ratio, data width, and number of brightness levels was established. Whereas normal bin height is optimal for corroborative detection and localization, a doubling or more of that height was needed to enhance early detection of weak targets. The number of bins selected for a display had greater impact on detection performance than bin or raster width. Performance improved with increased brightness levels. These outcomes suggest that an interactive display would permit optimal detection and tracking performance. Funding: ONR

Thomson, W. G. Passive sonar display studies (Tech. Rep. NUC TP 436).
Naval Undersea Center, June 1975.

Thomson, W. G. Passive sonar display studies (Tech. Rep. NUC TP 487).
Naval Undersea Center, September 1975.

NR 196-131 HUMAN FACTORS IN REMOTE UNDERSEA MANIPULATOR SYSTEMS Woods Hole Oceanographic Institution/Winget

The objective of this research is to develop human engineering guidelines for advanced remotely-controlled undersea manipulator systems in order to achieve an improved man-machine interface for this class of Navy undersea systems. The scientific goal is to determine relationships between control system design characteristics and operator performance with particular attention to force-feedback control and response dynamics. The approach entails manual control analysis, static tests of alternative control system configurations and dynamic operator control experiments. A repertoire of tasks representative of undersea work requirements for these systems is used to evaluate performance. Thus far, a comprehensive series of static and dynamic engineering tests has been completed that describes the fundamental characteristics of the bilateral system. Examples of these tests include: torque and rates produced as a function of control input signals; fidelity of force reflection in an arm loaded and unloaded condition; and system force-time responses as a function of forces encountered. Funding: ONR

Bertsche, W. R., Pesch, A. J. & Winget, C. Investigation of operator performance and related design variables in undersea force manipulator systems (Annual Summary Rep.). Woods Hole Oceanographic Institution, in press.

ENGINEERING PSYCHOLOGY PROGRAMS

NR 196-133 INVESTIGATION OF CONTROL AUGMENTATION AND INTEGRATED AIRCRAFT
DISPLAYS
University of Illinois/Williges

The objective of this research is to derive improved human engineering principles for the design of aircraft control and display systems through reallocation of the manual control tasks and improved integrated control display functional relationships. The central tasks involve systematic analysis, simulator experimentation and flight tests to determine alternate methods for distributing control authority between the pilot and automated portions of the control system in order to unburden the pilot without depriving him of the minimum essential control authority. Investigation of control orders, improved perceptual-motor matching, and the selective application of computer aiding underlie the research approach. Simulation studies have resulted in the software specification of a more flexible control allocation model. Perceptual experimentation is underway to assess the effectiveness of alternate sets of visual cues for landing. Progress has been made on the software for an experimental display system for integrating symbolic and graphic presentations of computer generated imagery.

Roscoe, S. N., Eisele, S. E. & Bergman, C. A. Advanced integrated aircraft displays and augmented flight control (Tech. Rep.).
University of Illinois, in press.

NR 196-134 INFORMATION DISPLAY SYSTEMS FOR MANNED WET SUBMERSIBLE
OPERATION
Oceanautics/Vaughan

The objective of this research is to develop human engineering guidelines and principles for the design of information display systems used in the ambient underwater environment. Emphasis is placed on environmental conditions, tasks and information display requirements attendant with the employment of manned wet submersibles in Naval inshore operations. The research builds upon data derived for the development of display systems used in the air medium as well as the body of data related to the effects of water immersion on the modification of human perceptual capabilities. Perceptual legibility experiments are conducted in cases where there are inadequate or ambiguous data. Main experimental variables relate to: type of visual task (e.g., quantitative reading, detection/identification); characteristics of the water environment (e.g., size and concentration of suspended particles, luminance and spectral distribution of ambient light energy); and display characteristics (e.g., display eccentricity, symbol size, luminance and wavelength).
Funding: ONR, NAVSEA

Vaughan, W. S., Jr., & Williams, J. An analysis of environmental and perceptual determinants of display legibility underwater. Oceanautics, Inc., in press.

NR 196-135 MAN-MACHINE INTERACTIONS IN TELECOMMUNICATIONS AND TELE-
CONFERENCING
The Johns Hopkins University/Chapanis

The Navy has a need to determine the most economical means of communication among physically separated individuals who must exchange information. This research studies man-machine problems in the use of various communication techniques which might be employed in teleconferencing situations.

ENGINEERING PSYCHOLOGY PROGRAMS

Experimental comparisons are made of the ability of groups of people to accomplish problem-solving tasks when communication among them is limited to the use of teleconference type devices. Primary variable is the richness of the communication medium (voice-plus-video, voice alone, teletype-writer, etc); secondary variables include type of task (fact-finding vs. persuasive), size of vocabulary, shared vs. individual terminals, and use of incentives to encourage brevity. The use and relative importance of communication media and aids during face-to-face conferences will also be examined. Performance measures include time to reach problem solution and amount of communication required. Funding: ONR

Weeks, G. C., & Chapanis, A. Cooperative versus conflictive problem solving in three telecommunication modes (Tech. Rep. 1). The Johns Hopkins University, August 1975. (AD A016 020)

Stoll, F. C., Hoecker, G. P., Krueger, G. P., & Chapanis, A. The effects of four communication modes on the structure of language used during cooperative problem solving (Tech. Rep. 2). The Johns Hopkins University, November 1975.

Kelly, M. J. Studies in interactive communication: Limited vocabulary natural language dialogue (Tech. Rep. 3). The Johns Hopkins University, December 1975. (AD A019 198)

NR 196-137 SIMULATION MODELING RELATIVE TO HUMAN FACTORS EFFECTS OF SHIP AUTOMATION
Applied Psychological Services/Siegel

The Navy is embarking on a concerted effort to achieve substantial reductions in ship manning requirements, largely through multipurpose and highly automated systems. There is a need to develop methods for predicting the impact of changes in personnel functions and reductions in crew size on the performance of crews during sustained missions. This research will investigate the applicability of simulation modeling methods for examining the effects of advanced automation on the allocation of shipboard functions and on the performance of the crew. Ship systems and functions which are now being considered for automation, or which may be in the future, are identified through literature analysis, interviews and extrapolations of emerging technological developments. They include propulsion, navigation, administrative functions, sensors, ship control, communications and others. Several types of stochastic models are being evaluated for their ability to provide estimates of the effects of these design developments on crew functions, performance, and ship manning requirements. Funding: ONR

Siegel, A. I., Wolf, J. J., & Williams, A. R. A method for predicting manning factors in post year 2000 ships (Tech. Rep.) Applied Psychological Services, December 1975.

NR 196-138 SONAR OPERATOR PERFORMANCE MODELING
Human Factors Research/Mackie

NAVSEA's Surface Ship Sonar Modernization Program is aimed at achieving long range improvements in man-machine function allocation, as well as short range improvements in display formats and operational procedures. This research focuses on the development of performance criteria and performance predictions for use in trade-off studies attendant with these goals. Technical specifications of advanced sonar display consoles are

ENGINEERING PSYCHOLOGY PROGRAMS

analyzed to identify appropriate functions and relevant variables affecting performance. Quantitative performance measures are estimated on the basis of prior research or ad hoc simulator experiments. Typical scenarios and operational sequence diagrams are developed which involve the various sonar operating modes. Stochastic simulation is employed to derive measures of performance and effectiveness of display formats and operating procedures. Funding: NAVSEA

NR 196-139 SHIP HABITABILITY DESIGN Naval Ship Engineering Center/Heffron

A significant amount of data has been and continues to be produced as a result of personnel and human factors research, yet it is not effectively utilized in the Navy ship design process. The objective of this investigation is to identify the types of personnel data needed and utilized in ship design, assess the resulting payoff, determine required future research efforts, and develop procedures for incorporating results of behavioral and organizational research into the ship design process. This initial effort focuses on the conceptual design of living and recreation spaces aboard an aircraft carrier; results will be generalized and expanded to cover other design phases, other ships, and working as well as living spaces. This research is jointly supported by the Engineering Psychology and Organizational Effectiveness Research Programs. Funding: ONR

NR 196-140 MAN-MACHINE COMMUNICATION IN ADAPTIVE CONTROL SYSTEMS Perceptronics, Inc./Weltman

The objective of this research is to develop human engineering design principles for improved man-machine communication in computer aided control systems. Effective use of advanced computers for interactive manned control requires systematic investigation of critical communication factors to determine structure and mode of command inputs, apportionment of control functions, and types of feedback denoting system and task status. Initial efforts focus upon a class of control-display elements common to general purpose work systems as represented by remote manipulation devices. Analytical studies will be followed by controlled laboratory experiments. The results of this work will have application to a range of remotely manned systems for Navy operations, such as recovery and repair underwater and in other hazardous environments. Funding: ONR

ENGINEERING PSYCHOLOGY PROGRAMS

TASK AREA: Performance Effectiveness

Performance Effectiveness examines human perceptual, psychomotor, and cognitive performance under conditions that are relevant to Navy missions. The objective is the development of laws and theories that will define human performance capabilities under the task, equipment, and environmental conditions that are likely for Navy and Marine Corps operations. Logical and mathematical model-building, laboratory simulation, and field tests are employed, as required, to analyze, measure, evaluate, and integrate data into forms that are useful to system designers.

NR 197-016 THE ROLE OF UTILITIES IN HUMAN INFORMATION PROCESSING Columbia University/Galanter

The consequences of operator judgments as well as the utility values they place on events is known to influence the reporting of target information; however, the quantitative relationships are not sufficiently developed to employ those functions for the improvement of human performance. The feasibility of scaling non-monetary events and the characterization of those events on a ratio scale was demonstrated in this program; utility judgments that represented either gains or losses of money were made to those events and agreed with previous data in which the utility of money is a power function with an exponent of almost one-half. Similar magnitude estimates of the utility of various occupations were collected from students but results indicated a lack of consistency or interpretability; it was indicated that only individual testing would yield useful data with this population. A monograph is in preparation which summarizes, analyzes, and evaluates the application of the concepts and theories of signal detectability and similar two-parameter decision theories to a variety of basic and applied problems. Funding: ONR

Galanter, E. Utility scales of monetary and non-monetary events (Tech. Rep. PLR-36). Columbia University, March 1975. (AD 008 231).

NR 197-017 CONDITIONS FOR IMPROVING VISUAL TARGET IDENTIFICATION The Johns Hopkins University/Egeth

The effectiveness of visual information processing in surveillance systems is critically dependent upon the physical characteristics of the displayed targets and non-targets, on the one hand, and on the search procedures required of the observer, on the other hand. This research investigates these factors in order to improve visual target identification. In one series of experiments, it was found that when letter targets (any alphabetic symbol) and non-targets were used and these letters were degraded or ambiguous, then the more similar the targets were to the non-targets, the more difficult the detection task. This effect of similarity is reduced with increased spatial separation between the letters. Evidence indicates strong superiority of english words over arbitrary symbols in visual displays (with certain important exceptions) and definite superiority of facial diagrams as a means for presenting integrated information quickly and accurately. Funding: ONR

Gilmore, G. C. The interaction among letters in a visual display (Tech. Rep. 77). The Johns Hopkins University, June 1975. (AD A012 435)

ENGINEERING PSYCHOLOGY PROGRAMS

Geoffrion, L. D. Lateral masking and the word superiority effect (Tech. Rep. 78). The Johns Hopkins University, June 1975. (AD A012 887)

Jacob, R. J. K., Egeth, H. E., & Bevan, W. The face as a data display (Tech. Rep. 79). The Johns Hopkins University, June 1975. (AD A013 352)

Gilmore, G. C., & Egeth, H. E. When are nonwords easy to see? (Tech. Rep. 80). The Johns Hopkins University, July 1975. (AD A013 331)

Egeth, H. E. Perception and attention (Tech. Rep. 81). The Johns Hopkins University, August 1975. (AD A014 215)

NR 197-020 FACTORS AFFECTING THE EFFICIENCY OF COMPUTER PROGRAMMING IBM/Miller

Highly-trained skills are required to code, debug and maintain current computer software. Problems occur when personnel lacking these skills are called upon to prepare programs. The objective of this research is to simplify certain programming tasks, thus reducing skill requirements. Experiments using programmers indicate that the most "natural" way to specify procedures is to emphasize the action to be taken with respect to some object, subject to various kinds of qualifications which typically appear after the imperative verb and object (such as "Put X into Y", or "Do A until B occurs".) These modes of expression are not used in conventional program languages, but are readily implemented into computer input formats. Another experiment evaluated the behavioral problems involved in "top-down" programming. It indicated that: (1) the horizontal segmentation of a process into successive sub-units was a critical aspect of the design process; and (2) the specification of the interrelations between tasks was a major problem. Inadequate or incorrect formulation of the problem for which the program is to be prepared has been found as a serious source of error. Experimental studies are underway to generate the optimal procedure for this stage of programming in the tasks of demand searching, ordering, sorting, and merging of data files. The natural language constructs and syntax used by the programmer prior to coding are examined as bases for standardization, specifying a preferred format, and avoiding design difficulties. These, and other outcomes from work in prior years, are employed to define and construct a set of performance aids and procedures to assist the programmer in all phases of programming (from problem-formulation through debugging and test). Funding: ONR

Miller, L. A., & Becker, C. A. Programming in natural English (Tech. Rep. RC 5137). IBM, Yorktown Heights: NY., November 1974. (AD A003 923)

NR 197-025 PROBLEM SOLVING WITH LIMITED INFORMATION Catholic University/Ross

An intelligence analyst collecting information about targets which have not previously been observed must build up a concept of the target on the basis of incomplete information. The development of aiding techniques to facilitate this type of problem solving, which is the thrust of this program, would increase the effectiveness of such analysts. The differential influence of rule-following and the nature of the available response categories (all, some, or none) upon the concept of target attained was examined. In those experiments which required observers to either recognize or produce instances of a given concept, the existence of matching rules led to greater accuracy and more frequent recognition

ENGINEERING PSYCHOLOGY PROGRAMS

of "all" instances. Disjunctive instances proved to be significantly more difficult to produce from conjunctive concepts than vice versa; these results held whether rules were given or not. The acquisition of concepts from given instances, followed by production of different instances of those concepts is examined, and then the same problems are examined in the reverse sequence. Ranking and forced-choice procedures that enlarge the range of recognition decisions and allow the introduction of reaction-time measures, are introduced to extend the analysis of observer responses. Funding: ONR

Ross, B. M., & Gurney, R. The deduction of concept instances with and without rules (Tech. Rep. CTRL-TR-2). Catholic University, February 1975. (AD A008 240)

Mott, T. H., Jr., & Ross, B. M. A logical description of the deduction of instances from concepts (Tech. Rep. CTRL-TR-3). Catholic University, May 1975. (AD A010 878)

NR 197-027 IDENTIFICATION OF PSYCHOLOGICAL FEATURES IN THE RECOGNITION OF COMPLEX, NON-SPEECH SOUNDS
Catholic University/Howard

Aural sonar displays (i.e., those which call upon auditory skills) are not competitive with machine-aided visual systems for initial target acquisition. However, auditory skills emerge as serious rivals: in target-tracking, in the extraction of tactical information, in the presence of noise interference, and in target classification. This program investigates the characteristics of auditory targets that are significant in classification and indicates those that recommend themselves for consideration in the design of future sonar systems and improved ASW sonar operator procedures. The fundamental-frequency of the auditory signal accounted for most of the classification variance, while waveform and formant-frequency were of lesser significance. Observers stressed different features and those observers that were musically-trained relied on the fundamental-frequency feature. Increases in the duration of the signal led to an increase in classification performance that reached an asymptote at 20-40 msec. In populations of naive and experienced sonar-operators, these major problems are being addressed: (1) the distinctive auditory characteristic which the observers choose as a function of their sonar skills and musical aptitude; (2) the physical characteristics of the signals and how they can be enhanced; (3) the form of memory coding for those multiple features that is selected by the observer; and (4) the effects of signal set and task-demands on performance. Funding: ONR

Howard, J. H., Jr., & Silverman, E. B. Structural components in the perception of sixteen complex sounds (Tech. Rep. ONR-75-1). Catholic University, August 1975. (AD A014 133)

NR 197-028 VISUAL DYNAMICS IN PROCESSING A SERIES OF DISPLAYS
University of Wisconsin/Robinson

The quantification of how an operator searches multiple, spatially-separated displays during monitoring and control tasks, and the elucidation of the serial processes operative in complex tasks, are required for the prediction of visual-search behavior. Results have been obtained on the dynamic patterns of eye and head movements when the observer was required to interrupt a central control task to acquire and process

ENGINEERING PSYCHOLOGY PROGRAMS

peripheral target information. These showed that there was a qualitative and quantitative difference from the case where there was no central on-going task. The effects of control order and bandwidth, as well as the status of the control at the time the peripheral search was commanded, were also found to be significant factors in performance. Head and eye movement patterns required for the sampling and processing of a peripheral target during a central tracking task of narrow bandwidth and sluggish dynamics are assessed for learning effects and the impact of variable cost ratios that favor either the control or the search task. In another experiment, the overlap of control response and search movements for a series of spatially-separated displays of variable complexity is examined. Funding: ONR

Robinson, G. H., & Bond, J. R. Visual dynamics when interrupting a control task to search for a peripheral target (Tech. Rep. TR-75-21). University of Wisconsin, Madison, October 1975. (AD A016 838)

NR 197-029 TAXONOMY AND VALUE OF DECISION ANALYTIC METHODS Decisions and Designs, Inc./Brown

Decision analysis has proven valuable in a variety of military and industrial situations, but there is a need for guidelines specifying those decision analytic methods most appropriate for different types of decision situations. This research is concerned with developing such guidelines. Decision analysis case studies being conducted under other contracts form the basis for developing a taxonomy of decision situations. The taxonomy is organized around characteristics such as time constraints, number of available options, degree of uncertainty, potential gains and losses, etc. These characteristics will be matched to various analytic methods and levels of analytic detail. In addition, an effort is being made to formulate and validate a method for estimating the value to be derived from the application of decision analysis to any given problem. Funding: ONR

Watson, S. R., & Brown, R. V. Issues in the value of decision analysis (Tech. Rep. 75-9). Decisions and Designs, Inc., November 1975.

Watson, S. R., & Brown, R. V. Case studies in the value of decision analysis (Tech. Rep. 75-10). Decisions and Designs, Inc., November 1975.

NR 197-030 MANNED SYSTEM DESIGN USING OPERATOR MEASURES AND CRITERIA Omnemii, Inc./Connelly

Displays forming the basis for vehicle control decisions should be matched to the characteristics of the human operator for a given set of operational situations. But present guidelines do not adequately consider the adaptive decision rules which operators employ to optimize their control performance. In this program, ship control performance of Officers of the Deck (OODs) is observed and analyzed in a series of simulator experiments involving ship transit and obstacle avoidance. Performance measures, based on task requirements, have been developed and include measures of closing rate, course-control performance and obstacle-avoidance performance. Control rules and criteria have been derived from individual performance measures and ship control commands; these have been expressed as a model which was tested by the adequacy with which it described the actual performance of other OODs. The OODs were also categorized into skill levels to determine how their respective decision

ENGINEERING PSYCHOLOGY PROGRAMS

criteria varied under the following conditions: displays with different orientation and content, changes in obstacle density, and variations in speed control. Funding: ONR

Connelly, E. M. Manned system design using operator measures and criteria (OMAC) data (Tech. Note C-35). Omnemil, Inc., June 1975.

NR 197-031 RESEARCH ON ADVANCED DECISION TECHNOLOGY
Decisions and Designs, Inc./Kelly

National security is critically dependent on the soundness of complex decisions reached by Defense planners. The best possible methods, procedures, and aids must be developed and implemented to facilitate and improve decision making. This research, focused on advanced decision analysis techniques, addresses an important part of that need. The approach involves theoretical analyses, experimental research, and on-line case studies. Theoretical analyses seek to determine the most parsimonious models for various decision situations. Experimental research examines the behavioral processes underlying judgments of probability and utility, quantifies the factors which bias these judgments, explores distortions of hindsight that affect evaluation of past decisions, and measures the effectiveness of decision aiding techniques. Case studies involve pilot application and evaluation of promising methods in real defense-oriented situations, facilitate their implementation through "user engineering", and develop methods for institutionalizing them in decision making organizations. This effort brings together under one prime integration contractor several of the leading decision research groups which have been conducting separate but related efforts in this area under ARPA support since 1973. Decisions and Designs, Inc. serves as integration contractor and conducts the case studies; Dr. Ronald Howard at Stanford University performs economic analyses of decision models; experimental work on human judgments and biases is conducted by Dr. Ward Edwards at the University of Southern California, and Dr. Paul Slovic and others at the Oregon Research Institute. Funding: ARPA

Brown, R. V. Modeling subsequent acts for decision analysis. Decisions and Designs, Inc., July 1975. (AD A018 888)

NR 197-034 SPATIAL ORIENTATION FROM HIGH-VELOCITY BLUR PATTERNS
University of Nevada/Harrington

Operations aboard high-velocity platforms or at ground RPV crew-stations often narrow the observer's view to the direct scene with a consequent blurring of peripheral events; the effect increases with the proximity and faster relative movement between platform and ground scene. A determination of the characteristics of that degradation, the useable informational features of the blurred scene, and the trade-offs with motion parameters, is essential for the development of performance aids to acquire and maximize peripheral perception under high-speed conditions. Performance aids will be evidenced in the determination of optimal field-of-view, the utility of eye movements to minimize blurring, selection of pattern gradients used on display devices and for landing surfaces, and training devices for the use of blur-pattern information. Funding: ONR

ENGINEERING PSYCHOLOGY PROGRAMS

NR 197-035 DEVELOPMENT AND UTILIZATION OF INTEGRATED MULTIDIMENSIONAL
DISPLAYS
University of Michigan/Pachella

Integrated and multi-function displays, are feasible alternatives to the proliferation of displays aboard naval platforms, but the optimal formats in which to present the data inputs and integrate them are incompletely specified for quantitative application. Guidelines are sought that consider the interdependence of: (a) the task demands associated with the utilization of the information extracted from an integrated display; (b) facilitation and/or interference among the graphic features with which those displays are constructed; and (c) the information-processing mechanisms within the observer that mediate the extraction and utilization of display information. Initial efforts are directed toward the selection and development of standardized display formats with five or more independently-variable attributes in order to construct displays in the form of schematic facial diagrams, n-sided polygons, and configurations of other geometric forms. The attributes to be examined include: brightness, size, angle, shape, position, temporal occurrence, and rotation. Subsequently, reaction-time experiments will assess several variations of the displays with tasks that require filtering and/or condensing of relevant information, and tasks that levy differential demands on perception, memory, or rule-following. Funding: ONR

PROJECT: OPERATIONAL DECISION AIDS

This is a multi-disciplinary Advanced Development Project, the purpose of which is to evaluate the feasibility and effectiveness of computer-based decision aiding techniques for improving tactical decision making in task force command and control systems. The techniques are derived from fundamental research in decision analysis procedures, computer sciences, systems analysis/operations research, and organizational analysis. The project is being conducted with participation by the Naval Analysis, Operations Research, and Information Systems Programs in the Mathematical and Information Sciences Division, and the Organizational Effectiveness Research Programs in the Psychological Sciences Division

NR 198-002 APPLICATION OF DECISION ANALYSIS TECHNOLOGY TO OPERATIONAL
DECISION AIDING AT THE TASK FORCE COMMAND LEVEL
Decisions and Designs, Inc./Peterson

Procedures derived from decision analysis research have been used successfully to aid human decision making in many applications where speed is not critical. This research determines the effectiveness of such procedures, incorporated into an interactive computer system, in facilitating tactical decisions at the task force command level. General specifications have been developed for decision aids to support planning and execution of tactics. A prototype system has been developed which allows a decision problem to be analyzed in advance; judgments about event probabilities, diagnosticity of indicators, and outcome preferences, are used to compute and display thresholds or decision rules for taking alternative actions, and continually changing probability levels for various possible threat conditions are also displayed. Judgments can be

ENGINEERING PSYCHOLOGY PROGRAMS

modified as necessary, combined with other techniques being developed by other contractors, and tested in a simulation facility using more realistic problem scenarios. Funding: ONR

Brown, R. V., Peterson, C. R., Shawcross, W. H., & Ulvida, J. W. Decision analysis as an element in an operational decision aiding system (Phase II) (Tech. Rep. 75-13). Decisions and Designs, Inc., November 1975. (AD A018 109)

NR 198-003X TASK FORCE DECISION ENVIRONMENT AND DECISION AIDS Stanford Research Institute/Rowney

In this component of the Operational Decision Aids project, the operational environment for decision making at the Task Force Command level is analyzed and categories of tactical decisions made during planning, underway and execution phases are identified. Two warfare scenarios are developed which incorporate these decision categories; the scenarios will form a basis for simulation experiments by other contractors during evaluation of proposed decision aids. Potential decision aids for a Task Force Commander and his staff are identified. This research is monitored by the Naval Analysis Programs of the Mathematical and Information Sciences Division. Funding: ONR

Payne, J. R., & Roney, J. V. ONRODA warfare scenario (NWRC-RM-83). Stanford Research Institute, June 1975.

Payne, J. R., Braunstein, T. J., Ketchel, J. M., & Pease, M. C. A brief survey of potential decision aids for the task force commander and his staff (NWRC-RM-84). Stanford Research Institute, August 1975.

Rowney, J. V. Amphibious warfare scenario (NWRD-RM-86). Stanford Research Institute, October 1975.

NR 198-004X DESIGN OF A COMPUTATIONAL TEST BED ENVIRONMENT FOR EVALUATING OPERATIONAL DECISION AIDS APPROPRIATE TO TASK FORCE LEVEL DECISION MAKING University of Pennsylvania/Morgan

This effort has two objectives. The first is to investigate the applicability of advanced computer software technologies as components of a decision aiding system at the task force command level. Thus far the following features have been examined and demonstrated: automatic configuration and reconfiguration of files according to user interrogation patterns; an alerting or triggering capability; and an English language interface. The second objective is to establish a computational test bed facility in which the aiding techniques being developed by other contractors can be incorporated and evaluated, singly and integrally, in a simulated tactical warfare scenario. This work is monitored by the Information Systems Programs of the Mathematical and Information Sciences Division. Funding: ONR

Hurst, E. G., Morgan, H. L., & Ness, D. N. DAISY: A decision-aiding information system (Working Paper 75-01-05). Wharton School, University of Pennsylvania, 22 January 1975.

Hurst, E. G., Morgan, H. L., & Ness, D. N. Decisions aiding information system (DAISY) user's guide (Working Paper 75-01-02). Wharton School, University of Pennsylvania, 22 January 1975.

ENGINEERING PSYCHOLOGY PROGRAMS

Hurst, E. G., Morgan, H. L., Ness, D. N., & Zowader, R. J. DAISY/APL interface user's memo (Working Paper 75-01-04). Wharton School, University of Pennsylvania, 23 January 1975.

NR 198-007X .MATHEMATICAL DECISION AIDS
General Research Corporation/Pugh

In this research an assessment is made of the potential usefulness of mathematical techniques (i.e., computerized models or algorithms) as aids to task force command decision making. An initial analysis identified appropriate roles for humans and computers in a generalized decision process. The two scenarios developed by SRI were then analyzed to develop a categorization of typical task force command decisions. A number of instances were identified in which "outcome calculators" dealing with air defense, ASW and air strike operations could be useful. Other instances were identified where decisions are dominated by relative unstructured political and psychological issues; these do not lend themselves easily to mathematical aiding. This effort is monitored by the Operations Research Programs of the Mathematical and Information Sciences Division. Funding: ONR

Pugh, G. Mathematical decision aids for the task commander and his staff (Tech. Rep. S93W-01-C12). General Research Corporation, in press.

NR 198-008X PERFORMANCE MEASURES FOR TACTICAL PLANNING AND OPERATIONAL
DECISION AIDS
Analytics, Inc./Martin

The objective of this effort is to develop measures for use in evaluating the decision aids produced in this project. A structure is developed for defining the various functions in the decision process, and a general measurement philosophy is presented which incorporates an asymptotic goodness measure and a time measure for scaling of performance. Specific measures are then proposed for each decision function. One such measure, involving the efficiency of information search and retrieval, is developed in some detail as an illustrative case. This work is monitored by the Naval Analysis Programs of the Mathematical and Information Sciences Division. Funding: ONR

NR 198-009 DECISION AIDS FOR NAVY TASK FORCE COMMAND AND CONTROL
Stanford Research Institute/Miller

This component of the Operational Decision Aids project focuses on developing procedures to aid in rapidly structuring a tactical decision problem so that appropriate judgments can be elicited. Experienced decision analysts work with representative Navy commanders on a range of typical problems and determine the simplest structural model appropriate for various types of decisions. Algorithms are developed to formalize the structuring process and to elicit the quantitative estimates needed to reach a solution. The elicitation procedures are designed to maximize internal consistency and minimize biases or errors due to judgmental approximations. The usefulness of these aids is tested in an interactive computer system using tactical problem scenarios. Funding: ONR

ENGINEERING PSYCHOLOGY PROGRAMS

Howard, R. A., Merkhofer, M. W., Miller, A. C. & Tani, S. N. A preliminary characterization of a decision structuring process for the task force commander and his staff (Tech. Rep. MSC-4030). Stanford Research Institute, December 1975.

NR 198-010 RESEARCH ON MAN-MACHINE INTERFACE TO AID TASK FORCE TACTICAL DECISIONS
Integrated Sciences Corporation/Irving

A key element in this program is that the decision maker or members of his staff be able to interact with a computer system to retrieve data, enter judgments, and create trial tactics for evaluation. This research focuses on specific methods of entering alternative task force deployments and routing plans into an information processing and display system, for tactics evaluation prior to and during mission execution. Display variables consist of (1) display of target position reports requiring unaided intuitive judgments, and (2) display of computed Bayesian threat probabilities based upon target position reports. Alternative controls being investigated are joystick, trackball and lightpen, for entering routes and probability contours. Performance measures are speed, accuracy, learning time and acceptance. Funding: ONR

NR 198-011X DATA AND DISPLAY SCENARIOS FOR TACTICAL FLAG DECISION AIDS
Grumman Aerospace Corporation/Stump

The objective of this effort is to assist the other project participants in developing realistic scenarios related to the planning, development and operational decision sequences of a task force commander and his staff. Utilizing extensive, indexed lists of data developed in previous research, the principal investigator is providing a basis for development of standard scenarios and decision sequences which incorporate data at an appropriate level of detail. Experiments are conducted to investigate alternate formats for data display. This effort is monitored by the Naval Analysis Programs of the Mathematical and Information Sciences Division. Funding: ONR

NR 198-012X DATA ELEMENT DEFINITION AND DISPLAY SEQUENCES FOR TASK FORCE COMMANDERS
CTEC, Inc./Crane

The planned simulation facility at the University of Pennsylvania, in which experimental evaluations of decision aids are to be conducted, requires a data base which is representative of the real data normally available to task force command staffs. This effort is concerned with analyzing the availability and size of data bases for future tactical flag command centers, and identifying a sub-set of data which is realistic in nature and sufficient for the conduct of simulation experiments based on the scenarios developed by other contractors. This work is monitored by the Naval Analysis Programs of the Mathematical and Information Sciences Division. Funding: ONR

ENGINEERING PSYCHOLOGY PROGRAMS

NR 198-013X EVALUATION OF THE IMPACT OF OPERATIONAL DECISIONS AIDS ON
TASK FORCE COMMAND ORGANIZATIONAL STRUCTURE
CACI, Inc./Spector

As task force command staffs are presently structured, the Task Force Commander (TFC) receives inputs for tactical decision making from approximately twenty staff officers whose roles as advisors are largely individualized, and whose utilization depends heavily on the nature of the tactical problem and the individual preferences or styles of specific TFC's. As more systematized and computer-based approaches are introduced, it may well be that changes in organizational structure or function allocation of such groups will be necessitated to exploit fully the value of these new aids. This is the domain explored in this research. Literature and case studies are examined to identify desirable organizational changes in the task force command structure with the advent of computer-based decision aids; implementation strategies are developed for instituting such changes. This effort is monitored by the Organizational Effectiveness Research Programs. Funding: ONR

COMPLETED WORK UNITS

This section consists of short summaries of research and development efforts (work units) which have been completed since last year's presentation.

NR 150-329 ASSESSMENT OF ABILITIES AND CHARACTERISTICS OF NAVY
PERSONNEL
Educational Testing Service/Harman

The assessment of abilities and aptitudes is important to the Navy in connection with selection, job assignment, and training. Poor matching between capabilities and job requirements is a potential source of wasted training time, poor performance on the job, and poor personnel retention. The Navy requires techniques for rapidly developing adequate new tests for predicting performance in training and on the job. This contract relates to that need, in that it attempts to contribute to a better fundamental understanding of human cognitive abilities--what they are, and how they relate to each other. The target was to identify those basic abilities on which performance of any task must depend. As a secondary effort, the contract has also attempted a similar contribution to the domain of temperament factors, a domain less well developed than the cognitive.

The investigators took as their departure point a reference kit of cognitive factors and a summary of the field of ability assessment, both completed by the Educational Testing Service (ETS) in 1963 under a prior ONR contract. To start off, a conference of experts in the area of factor analysis and human assessment was convened in 1971 at which guidelines for use in the study itself were laid down. Then the literature since 1963 was searched, for (a) new evidence that might modify the abilities identified earlier; and (b) evidence concerning new abilities not previously identified. Based on the literature search, decisions were made concerning which abilities seemed well established; and tests were developed to best measure them. With the assistance of professional personnel at the Navy Personnel R&D Center, who made substantive contributions as well as expediting test administrations, these experimental instruments were field-tested on large samples of Navy recruits and revised in the light of the information thus provided. The tests, in final form, have been made available to all professionals in the form of a revised (1975) Kit of Factor-Referenced Cognitive Tests, published by the Educational Testing Service, which should be useful in the construction of ability tests for any specific purpose.

A similar procedure was followed with regard to temperament factors. However, since this was a first attempt to provide reference materials for such factors, the end product is more modestly described as a Guide to Factor-Referenced Temperament Scales, rather than a definitive Kit.

Eight technical reports were issued during the contract. The final report, noted below, summarizes all of these and provides an excellent overview of the research, as well as a list of the marker tests for 23 cognitive factors and of the marker scales for 28 temperament factors. Funding: ONR

Harman, H. H. Final report of research on assessing human abilities.
Educational Testing Service, July 1975. (AD A015 027)

COMPLETED WORK UNITS

NR 150-343 COMPUTER-BASED ABILITY ASSESSMENT
University of Minnesota/Weiss

Ability measurement is a fundamental tool in personnel selection, placement promotion and training. Improvements in the accuracy of ability measurements will result in important cost savings. This research, begun in 1972, was concerned with the improvement of ability testing procedures, by redesigning ability tests for administration by on-line computers. A primary purpose of the research was to determine the nature and extent of increases in measurement accuracy made possible by the variety of approaches available for computerized adaptive testing. An additional goal of the research was to investigate the potential beneficial psychological effects of computerized testing, in terms of reduced test anxiety and increased test-taking motivation.

The evaluation of different strategies of adaptive testing was approached by a systematic combination of live-testing studies and computer simulation studies. The live-testing studies showed that adaptive tests generally had higher test-retest reliabilities than conventional tests, implying greater utility in making longitudinal predictions about individuals. By using response consistency as a moderator variable derived from one strategy of adaptive testing, extremely high, short-term, test-retest reliabilities were obtained. It was also found that adaptive tests, using considerably fewer test items, could measure as well as conventional tests, thus resulting in time savings which could be used for measurement of other job-relevant abilities.

The computer simulation studies confirmed and extended the findings from the live-testing studies. In general, these studies showed that certain adaptive testing strategies were able to achieve measurement of equal precision throughout the range of measured ability, in contrast to conventional tests which measure accurately only for a small portion of the ability range. (Some adaptive tests actually measured more accurately than conventional tests throughout the ability range, a finding contradictory to that of test theoretical predictions.) Adaptive test scores in general also better reflected the distribution of underlying ability, and predicted actual ability better than did conventional tests.

Studies on the psychological effects indicated that adaptive testing and/or the provision of immediate knowledge of results after each test question has beneficial motivational effects. One study showed that immediate knowledge of results on a computer-administered conventional test resulted in test scores for a group of black students which were not different from those of white students; without knowledge of results, the two groups had significantly different mean scores. A second study showed that immediate knowledge of results increased ability scores for both high and low ability testees, and that adaptive testing differentially increased ability scores for low ability testees. Additional data from these studies supported a motivational interpretation for these increases in test scores.

The Navy Personnel R&D Center (NPRDC) has maintained strong interest in this research, and plans to follow it up with in-house research. ARPA is interested in extending Weiss' approach to criterion-referenced achievement testing, and has recently contracted with him, through ONR, to do so.

The final report, expected to be available by March 1976, will summarize the fourteen technical reports issued under the contract. The following three of these reports should prove especially helpful in acquainting the reader with the broad issues of the research. Funding: ONR

COMPLETED WORK UNITS

Weiss, D. J., & Betz, N. E. Ability measurement: Conventional or adaptive? (Res. Rep. 73-1). University of Minnesota, February 1973. (AD 757 788)

Weiss, D. J. Strategies of adaptive ability measurement (Res. Rep. 74-5). University of Minnesota, December 1974. (AD A004 270)

Weiss, D. J. (Ed.). Computerized adaptive trait measurement: Problems and prospects (Res. Rep. 75-5). University of Minnesota, November 1975. (AD A018 675)

NR 150-367 MEASURES OF AVERAGED EVOKED CORTICAL POTENTIAL AS POSSIBLE PREDICTORS OF LEARNING POTENTIAL AND PERFORMANCE
Navy Personnel Research & Development Center/Rimland

Twenty years of experience with various types of cognitive and noncognitive paper and pencil tests, used in predicting a variety of criteria, served as a departure point for some researchers at the Navy Personnel R&D Center (NPRDC) in San Diego to think about novel approaches in the field of psychometrics. The area of psychobiology was seen as being in a rapid state of development, and as holding promise for providing objective measures of individual differences in ability and performance potential. With ONR support, NPRDC established a joint brain-wave research project with the Langley Porter Neuropsychiatric Research Institute (LPNRI) which had previously, with ONR funding, developed an outstanding capability in the brain-wave field. Several samples of Navy Recruits have been tested in a series of "shake-down" projects for NPRDC. These recruit populations are being followed up to obtain fleet-performance data, which will be used in validating certain of the brain-wave measures. The collaboration with LPNRI is continuing. Funding: ONR

NR 151-347 METHODS FOR PREDICTING JOB-ABILITY REQUIREMENTS FROM CHARACTERISTICS OF TASKS TO BE PERFORMED
American Institutes for Research/Wheaton

Optimum use of the abilities of Navy personnel requires effective selection of people for training and for job assignment. This selection, in turn, requires systematic knowledge as a basis for translating information about the task to be performed into information about the kinds of operator capabilities and skills required for successful performance. This work has aimed at providing concrete empirical data with which to refine earlier conceptualizations of the interplay between task demands and ability requirements. The ultimate goal of work along these lines is to provide Navy task analysts with the tools needed to (a) describe the nature of a given task, (b) infer the kinds of human abilities the task requires, and (c) specify how ability requirements would change if selected features of the task were changed.

Wheaton and colleagues, starting in 1972, have investigated three classes of tasks, chosen to be representative of tasks prevalent in the Navy, as well as of some theoretical interest. These were auditory signal identification, electronic troubleshooting, and problem solving. Throughout the studies the approach was the same: (a) subjects were administered a battery of basic ability tests, chosen to be appropriate to the

COMPLETED WORK UNITS

task at hand, from which individual ability profiles could be derived; (b) the same subjects performed on systematic variations of the particular task; (c) the ability profiles were then statistically related to the performance data, yielding a great deal of detailed information about how ability requirements change as task characteristics change.

The empirical results were surprisingly complex. For example, in the signal identification task, an Auditory Perception ability factor appeared as important in performance at all levels of difficulty tested. However, as background noise increased, loadings on this ability increased for certain types of simulated targets (cargoships and light craft), but decreased for other types (warships and submarines). In the final task studied (problem solving), it was found that covariation of abilities with performance did not seem to be a simple function of task manipulations. These last complexities led to some hypotheses about choice of strategy in problem-solving situations, and to individual differences in how problems and tasks are perceived. Data from the troubleshooting and problem-solving studies were re-analyzed with a view to highlighting the role of individual strategies. Again, complex interactions were found.

This work has provided the Navy with an improved knowledge base for its selection approaches. It has shown that abilities are sensitive to differences among tasks, and thus that a good taxonomy of tasks is an essential tool for selection. In one large class of instances, an increase in task difficulty simply makes the underlying ability required more important; but in another class, even subtle variations in the task seem to change the subject's perception of it so that a new pattern of underlying abilities emerges as important. Improved personnel assignment obviously requires better information about strategies and their interactions with both abilities and performance.

The final report of this work, shown below, summarizes the three earlier technical reports, while also serving as a technical report on the fourth and last study, which examined interactions within the context of troubleshooting and problem-solving tasks. Funding: ONR

Wheaton, G. R., Rose, A. M., & Fingerman, P. W. Methods for predicting job-ability requirements, IV: Task characteristics, ability requirements, and problem-solving strategies (Final Rep. R75-2). American Institutes for Research, September 1975.

NR 151-350 FACTORS AFFECTING JOB STABILITY AND PERSONNEL
RETENTION
University of Maryland/Schneider

Employee turnover has long been a focus of psychological research in business, industry and the military; turnover can be a costly phenomenon if too high, especially given the investments made in recruitment, selection and training of personnel. Approaches to the turnover problem have, in the past, concentrated on two strategies: (1) assessment of personnel attributes of employees prior to hire and development of valid predictors of turnover or (2) assessment of job satisfaction at one point in time and prediction of turnover at a subsequent point in time. Neither approach has yielded much capability to predict turnover.

This research, starting in 1972, focused on the feasibility of utilizing some non-traditional indices of the tendency to leave an employing organization. A review of the turnover literature and revealed a very

COMPLETED WORK UNITS

heavy concentration on the satisfaction experienced by people with features of their current job. Very little attention was paid to the nature of the organization in which people worked, to the life stage of people and their families, to the availability of alternative forms of employment, or to the role of the target job in the person's view of his or her career.

Interviews with about 100 people (employees and their families) suggested that an important way to conceptualize both career and family issues would be the extent to which the current job was viewed as having a positive or negative impact on the family or career. Interviewees also referred to the "climate" or "feeling" of workplaces as an important factor in thoughts of turnover; climate became a central concern as a way of organizing a great deal of information people felt they had about an organization and which impacted on their plans for the future.

A survey measure was developed for administration to employees that included six major sections: climate perceptions (including organization, job and task perceptions), impact of organization on career, impact of organization on family, availability of alternatives, job satisfaction, and turnover intentions.

Due to the extensive nature of the analysis necessary to fully exploit the survey data, publication of the final report has been delayed. The final report will integrate the complex findings and offer broad policy recommendations. Eleven technical reports have been distributed. In addition, based on this work, five journal articles and one book chapter have already been published. A number of professional colleagues have requested, for possible use, several measures (e.g., surveys) developed under this contract. Funding: ONR

Schneider, B. Organization type, organization success and the prediction of individual performance (Res. Rep. 6). University of Maryland, May 1974. (AD 783 966)

Schneider, B. Conceptualizing organizational climates (Res. Rep. 7). University of Maryland, May 1974. (AD 783 064)

Schneider, B., & Snyder, R. A. Some relationships among and between measures of employee perceptions and other indices of organizational effectiveness (Res. Rep. 5). University of Maryland, May 1974. (AD 781 888)

NR 151-351 INCREASING THE INTRINSIC REWARD VALUE IN NAVY JOBS AND CAREERS
University of Akron/Barrett

In the all-volunteer force, the Navy must compete in the civilian manpower market. To compete effectively the Navy must select and train the best men and women available and also design jobs which are inherently rewarding. Since 1974, this effort has focused on the complex interactions between task attributes and individual characteristics, and the effects of these interactions upon job performance, satisfaction, and Navy tenure. The basic thrust was to develop a conceptual model of individual behavior within Navy-type organizations, with the ultimate aim of allowing a cost/benefit approach in decision making concerned with job placement, job design and training. To study the interactions of these variables, laboratory simulations of monitoring and maintenance operations were constructed. Field studies of actual Naval personnel performing maintenance

COMPLETED WORK UNITS

and monitoring functions served as a basis for the construction of these simulations and for the development of the measurement instruments.

The results obtained differed in several respects from those previously reported in the scientific literature. For example, both the field and laboratory studies indicated that there is not a unitary set of core attributes common to all jobs. That is, attributes which are important for any particular work position are often somewhat unique to it. Evidently, in job design studies, it will be necessary to determine the salient set of attributes for each work task considered.

It was further found that individual abilities are the single most important factor determining not only performance, but also the satisfaction of the individual performing the task (and, ultimately, his tenure). But this is not to say that the relationship is positive. In fact, results of a field study involving Navy monitoring personnel indicated that the higher either general or specific aptitude test scores are, the lower the expressed intention to continue Navy service.

A simple model emerging from this research indicates that individuals' general and specific abilities and values affect their preferences for, and their perceptions of, the structural attributes of jobs. The discrepancy between these two variables is in turn related to both satisfaction and tenure. Therefore, if the Navy continues to select individuals with the highest ability, it appears that an attempt must be made to either place these individuals on jobs in which the intrinsic reward value is concomitant with their abilities or to redesign the job to fit their preferences. The model suggests that either of these approaches should increase job satisfaction and decrease turnover. For more detail and further references, the reader is referred to the final report cited below.

Barrett, G. V., & Dambrot, F. H. Final report: Field and laboratory studies for increasing the intrinsic reward value in navy jobs and careers (Tech. Rep. No. 8). University of Akron, August 1975.

NR 154-326 HOW BEST TO IMPROVE AND INDIVIDUALIZE NAVY TRAINING BY USE
 OF COMPUTERIZED INSTRUCTION
 Stanford University/Atkinson

Exploring ways of using computer-assisted instruction (CAI) in Navy Technical training to effect greater efficiency and better learning has been an ONR research objective for several years. The research conducted at Stanford University on CAI has been extensive, with ONR and ARPA funding supporting a major part of the effort in recent years. CAI has been used in connection with courses in foreign languages and computer programming. A considerable volume of student-performance data has been gathered and analyzed. These data have led to improvements in the CAI program for instruction in the BASIC programming language so that, in its present form, it is more individualized than the earlier Stanford CAI program which was used to teach the AID programming language. The decision rules used to organize the material in the most advantageous way for individual students, however, remain rather simple. Research into such decision rules will continue at Stanford. Further development of the BASIC Instructional Program by the Stanford group is being funded by the Navy Personnel R&D Center. In the area of foreign language instruction, a mnemonic method has been developed to help students learn vocabulary, and this technique was shown to improve vocabulary acquisition. Also in connection with instruction in foreign language, strategies for presentation-sequence optimization were studied. Both the BASIC and the foreign

COMPLETED WORK UNITS

language programs have been used extensively in credit courses at Stanford and other nearby institutions. The Final Report from this project summarizes the contents of the eleven technical reports and the several journal articles, book chapters, etc., produced. Funding: ONR, ARPA

Beard, M., Barr, A., Fletcher, D., & Atkinson, R. C. The improvement and individualization of computer-assisted instruction (Final Rep.). Stanford University, September 1975.

NR 154-330 IMPROVING INTERACTIVE CAPABILITIES IN COMPUTER-ASSISTED INSTRUCTION
Bolt, Beranek and Newman, Inc./Collins

The Navy's need for effective and efficient training technologies is great, in view of the large number of people who require training in a wide variety of subject matters each year. A major educational technology which has emerged in the last ten years is computer-assisted instruction (CAI), which allows a computer to take over some of the functions of a human teacher, and which also allows more complete control over the presentation of material to the student. This investigator is in the forefront of new developments in CAI technology. Under this contract he and his colleagues have been working to give CAI increased flexibility and responsiveness to the individual student, and in fact hope to impart to the instruction some of the quality of tutorial or one-to-one teaching.

Collins works with a CAI system called SCHOLAR. This system is the first of its kind, and its uniqueness lies in the fact that it stores "knowledge about the world" in a semantic network, cross-referenced like an encyclopedia. With the data base stored in this way, programs can be written with much greater flexibility of operation which allow for considerable interaction between student and computer. That is, the system can adapt itself to the student's level of information and responses as the training proceeds (instead of running a pre-set agenda) and the student can put specific questions to the system. With this capability, the question is one of finding the best software for specific educational purposes.

Collins has taken the path of studying what actually occurs between human students and tutors, as a model for what the computerized system ought to be able to do. In particular he was able to identify four crucial aspects of tutorial strategy, all of which he was able to incorporate into SCHOLAR's way of teaching: (a) the way tutors select topics, (b) the way they interweave questions and presentation, (c) their reviewing, and (d) their error-correction strategy. Recognizing that tutorial strategies will probably vary depending on the kind of subject matter being taught, the contract has included work on tutoring (by means of SCHOLAR) not only (a) factual knowledge (e.g., verbal information about geography), but also (b) visual knowledge (using computer generated maps to teach geography), (c) procedural knowledge (e.g., how to use the ARPA network, as well as a test-editing subsystem of the network called NLS), and (d) functional or causal knowledge.

The payoff in all this comes from personalizing the learning process: forcing the student to participate in learning, teaching at the level of the individual student's knowledge, providing a setting where the student

COMPLETED WORK UNITS

can try out his own ideas and make mistakes, freeing the student from peer pressure, addressing the student's individual confusions, etc. The cost of building and running such a system is high but should be competitive compared to the cost of human tutoring within a short time, especially where few skilled teachers are available. Funding: ONR, ARPA

The many technical reports, book chapters, and journal articles emanating from this work are summarized and referenced in the final report.

Collins, A. M., & Grignetti, M. C. Intelligent CAI (Final Rep.). Bolt, Beranek & Newman, Inc., October 1975.

NR 154-344 TECHNIQUES FOR IMPROVING THE PERFORMANCE-EVALUATION
PROCESS FOR NAVY ENLISTED PERSONNEL
R-K Research and System Design/Ramsey-Klee

This work sought to improve the process by which the performance of Navy enlisted personnel is evaluated. The way in which these periodic performance ratings are now completed sometimes leads to a pile-up of marks at the high end of the scale. The approach investigated here applied content-analytic techniques to the narrative sections of performance-evaluation ratings, and resulted in two procedures for extracting information they contained which could more sensitively differentiate among those rated. Training manuals for applying these two procedures were also prepared.

In the course of this work, begun in 1972, narrative performance evaluations for over one thousand enlisted personnel in ten occupational specialties spanning Pay Grades E5, E6, and E7 were subjected to content analysis. Three reliability studies were conducted, all resulting in quite respectable levels of agreement among indexers who independently content-analyzed the same three sets of narrative evaluation comments. The major findings resulting from this research are the following. Quantitative variables derived from the content analysis can be used to classify enlisted men into job-performance criterion groups with a high degree of accuracy ranging from 79% to 100% for Pay Grade E7. At Pay Grades E5 and E6, classification accuracy is slightly less. Better classification is achieved if each occupational specialty is analyzed separately. The narrative comments contained in the "Justification" Section of personnel-evaluation reports yielded better classification accuracy than those contained in the "Evaluation" Section. The most discriminating variable in all of the analyses that were conducted was a variable that reflects the variety of specific areas of an individual's job performance that an evaluator chose to mention narratively.

Of the two content-analysis procedures that were developed, the shorter, simplified method can be applied for about 60% of the cost of the lengthier, more complex method, with little loss in classification accuracy.

Members of the staff at the Navy Personnel Research and Development Center responsible for upgrading Navy performance-evaluation procedures were briefed on this work throughout the effort, and plan to follow up on this promising approach. Four technical reports have been issued to date under this contract; one more technical report and the final report are in preparation. The latter will summarize all of the work, findings and recommendations. The most recent report issued is shown below. Funding:
ONR

COMPLETED WORK UNITS

Ramsey-Klee, D. M., & Richman, V. Further investigations of content analytic techniques for extracting the differentiating information contained in the narrative sections of performance evaluations for Navy enlisted personnel (Tech. Rep. 75-1). R-K Research and System Design, October 1975. (AD A018 248)

NR 154-357 EVALUATION OF PURPOSES, PLANS, PROCESSES, AND PRODUCTS OF EDUCATION AND TRAINING SYSTEMS
Educational Testing Service/Anderson & Ball

The impetus for this contract was a concern within the Navy about the adequacy of its present training efforts. In considering innovations in training, the Navy indicated eagerness to have evaluation made an integral part of such programs. This contract aimed at pulling together, in a comprehensive and easily useable form, the best knowledge available about the theories and techniques of evaluation.

Major results are published in a book titled The Encyclopedia of Educational Evaluation (Anderson, S., Ball, S., Murphy, R. and associates, Jossey-Bass, 1975). This comprises 134 short articles giving essential information about key concepts and techniques under the following general headings: Evaluation Models, Functions and Targets of Evaluation, Program Objectives and Standards, Social Context of Evaluation, Planning and Design, Systems Technologies, Variables, Measurement Approaches and Types, Technical Measurement Considerations, Reactive Concerns, Analysis and Interpretation. The book has received very favorable reviews, and should serve to make the technology of evaluation readily accessible to those responsible for Navy training and education programs, as well as to the training community at large. For example, 50 copies were requested by, and supplied to, the Chief of Naval Technical Training for distribution to training activities of his Command.

The second task undertaken was a survey of actual evaluation practices in various settings involving adult education/training programs (Department of Defense, other government agencies, and industrial/commercial organizations). A sample of 200 such programs and their evaluations was surveyed by questionnaire; of these, 14 selected as exemplary were followed up by site visits for in-depth study. At least a quarter of the evaluations were found to be unplanned and of poor quality, and even among the rest it seemed clear that available knowledge about evaluation is not widely used. Of the four categories of programs sampled, those of the Department of Defense appeared the most nearly adequate.

The survey was useful in isolating certain key areas of concern to evaluators. To address themselves to these areas the investigators held a conference of leading professional evaluators; building on the contributions made there, they prepared a Technical Report on Professional Issues in the Evaluation of Education/Training Programs: which (a) lists common evaluation purposes along with the general methods of investigation most apt for each; (b) lists types and sources of evidence and links them with general methods of investigation; (c) spells out the types of relationship which might be found among program evaluator, program developer/director, and funding agent; (d) provides a checklist of audiences for, dissemination of results indicating appropriate communication forms for each audience; (e) lists the needed competencies of evaluators; (f) discusses the ethical responsibilities of evaluators; and (g) defines various value orientations of evaluators and how they may be communicated to others.

COMPLETED WORK UNITS

Planners and directors of Navy education and training programs now have at their disposal increased and focused information with which to assess and improve their efforts. This is summarized in the final project report.

Anderson, S. B., Ball, S. Evaluation of purposes, plans, processes, and products of education and training systems: Final summary report (Final Rep.). Educational Testing Service, October 1975. (AD A017 870)

NR 154-362 INSTRUCTIONAL THEORY RELATING LEARNING TO SPEAK, TO READ,
AND TO COMPREHEND COMPLEX INFORMATION
University of California, Irvine/Hamburger & Wexler

The Navy faces the serious problem that many of its recruits, and many potential recruits (who are now rejected) cannot read sufficiently well to benefit from technical training. This research was mounted in an effort to develop the theoretical basis for a reading program for functionally illiterate young adults and to test that program experimentally.

The theoretical work has been successful and well received. The two technical reports mentioned below have dealt successfully with questions of learnability of grammars, i.e., with the question of what sorts of learning processes could and what sorts could not be the basis for learning a transformational grammar, i.e., of English.

A number of difficulties plagued the experimental work, however, and the contract came to a close when it became evident that these difficulties could not be resolved at the present time. Funding: ONR, ARPA

Hamburger, H., & Wexler, K. A mathematical theory of learning transformational grammar (Tech. Rep. 1). University of California, November 1973.

Wexler, K., Culicover, P., & Hamburger, H. Learning theoretic foundations of linguistic universals (Tech. Rep. 2). University of California, November 1974.

NR 155-341 CONVERSATIONAL COMPUTER CONTROL OF MANPOWER PLANNING MODELS
Carnegie-Mellon University/Thompson

The use of manpower planning models requires an effective interface between the manager/manpower analyst and the computer support system. A technology which is becoming important is conversational computer control of manpower models. In this case, the interactive dialogue is in the natural language of the users and allows them to assess the effects on future manpower of alternative policies associated with manpower planning. This investigator is among the leaders in the field of the interactive use of large-scale mathematical programming models. Under this contract he, jointly with researchers in the Office of Civilian Manpower Management, has moved this technology through several prototype stages. Currently, the testing is being accomplished: (a) in conjunction with the management of a large Naval laboratory, and (b) as part of the examination of broad civilian career planning policies by Navy headquarters officials.

The manpower models used in these tests deal with intake or recruiting requirements planning. These goal-programming models developed by Charnes, Cooper and Niehaus are supported by comprehensive computer software, including a specialized matrix generator and conversational statement

COMPLETED WORK UNITS

repertoire. The manpower model is concerned with the idea of trying to meet manpower requirements "as closely as possible" for a number of periods in the future. This is done by setting various priorities and penalties for moving away from the goals. Also, constraints are set within which the requirements must be met. They may include: manpower already on-board; attrition (including retirements and internal transfers between job categories); total manpower controls; and total salary budgets.

Thompson and his colleagues have shown through the managerial tests both the usefulness of the models as well as a method of providing insights into the course to follow in the research. It was clear from the tests that the conversational environment should be designed to support staff analysts in conjunction with managers rather than the managers alone. The tests also indicated that the hardware configuration is of importance. It appears highly desirable to have an intelligent CRT terminal with a printer capable of producing standard (132 character line) computer output running using higher speed lines (300 baud minimum, 1200 baud more desirable). The conversational model, even in its present form, represents a vast improvement over previous support procedures. The managers and their non-computer-trained staff analysts appeared considerably more comfortable with the model. This came with their realization that they had direct control over the model in support of their decision making.

The continuation of the conversational research is being accomplished as part of the Shore Activity Manpower Planning System (SAMPS) advanced development research project supported by the Navy Personnel R&D Center. The purpose of the SAMPS project is large-scale feasibility tests of the manpower planning models at Naval shore activities using minicomputers in a data communications network. The following two reports describe the activities under this contract. The final report is in preparation.
Funding: ONR

Srinivasan, V., & Thompson, G. L. Alternate formulations for static multiattribute assignment models (Tech. Rep. 1). Carnegie-Mellon University, April 1973.

Curry, C. Attitudes affecting turnover of Navy civilian employees (Tech. Rep. 2). Carnegie-Mellon University, March 1974.

NR 156-036X THE IMPLICATIONS OF SOCIETAL CHANGE FOR NAVY MANPOWER PRACTICES
University of Michigan/Bowers

This project, which began in 1972 and ended in June 1975, was designed to assess the probable impact upon Navy management practices of value and attitudinal changes. For this reason, a representative national cross-section of American adults (age 15 and over) completed questionnaires. Questionnaires were also administered to a sample of Navy men.

The findings are encompassed in the volume Navy Manpower (submitted as the final report) and has to do principally with value and attitude implications for operating management in the Navy. Persons in the Navy and civilian life wanted similar things in their jobs. However, younger individuals, probably because of improved and enriched education, are much more resistant than their elders to autocratic management practices.

Some 17 technical reports were distributed and additional applied work with Human Resources Management consultants was undertaken (see NR 170-

COMPLETED WORK UNITS

765). Efforts to inform the Navy took the form of briefings of top level Navy policy makers and of representatives of the Manpower R&D Program. Perhaps the most significant effect of this research is the influence it exerted upon the Navy's Human Goals Program. Funding: ONR

Bowers, D. G. Navy manpower: Values, practices and human resources requirements (Final Rep.). University of Michigan, June 1975. (AD A014 493)

NR 156-042X A COMPREHENSIVE JUNIOR COLLEGE SURVEY OF NAVY RECRUITMENT POTENTIAL
Hay Associates/Fisher

During April and May, 1975, approximately 800 male junior college students, enrolled in a national sample of 20 community and junior colleges, were surveyed. The purpose of the survey was to estimate the likelihood that such young men would join the Navy. The significance of the junior college as a recruiting target was twofold: (a) it had not been exploited by Navy recruiters, and (b) there is an estimated 1.6 million male students, and enrollments in community colleges are projected to increase at a greater rate than those in four-year higher institutions. The survey sought to determine educational and job aspirations attitudes toward military service, preferences for officer or enlisted status, incentives for enlistment, and previous experience with military recruiters and recruiting techniques.

Findings showed that two-year college students are a promising recruitment target. Favorable or neutral attitudes toward military service are high and have increased since the early 1970's. Demographic factors, such as age, race, and family income, were generally unrelated to enlistment potential. Choice of branch of service and opportunity to learn skills useful in later civilian life were the most frequently named reasons for wishing to enlist. The GI Bill was the most popular enlistment incentive. The most preferred recruitment technique was direct contact with Navy recruiters, as opposed to reading about the Navy. Major career influences were parents and male peers.

The scientific community has been informed of this work by a published technical report (see citation below) and a well-attended briefing by the principal investigator. Navy and Marine corps personnel, particularly those involved in recruiting, have been briefed several times. Headquarters, Navy Recruiting Command, has used the results of this work to regenerate interest in community colleges on the part of field activities. Some of the supporting data from the research--that dealing with minority images of the Navy--has been provided to the CNO Task Force on Equal Opportunity as background material. Funding: Navy Recruiting Command

Fisher, A. H., Jr., Pappas, L. D., & Shepherdson, S. Navy recruitment potential in junior colleges (Tech. Rep. 76-1). Hay Associates, July 1975. (AD A013 670)

NR 156-049X ENLISTED PERSONNEL ATTRITION
American Institutes for Research/Goodstadt

During the summer of 1975, this work was undertaken to provide background material in support of a new research program dealing with the high attrition of first-term enlisted personnel. The approach was four-fold:

COMPLETED WORK UNITS

(a) to document what is known about enlisted attrition experience in the Navy and Marine Corps; (b) to review previous R&D on the subject; (c) to recommend new research that should be undertaken; and (d) to provide information to personnel and manpower policy makers and managers. Sources of information included: Bureau of Naval Personnel data bases, Marine Corps manpower planners, files of the Manpower Analysis Research and Development Center, and several non-military organizations (e.g., Bureau of Labor Statistics).

Among the major findings reported were: (a) one third of first-term Navy men do not complete their obligated service; (b) most (70%) of this attrition is attributed to "motivational" problems; (c) attrition appears to be lower among military personnel than in comparable age cohorts in industry; (d) little is known about the conditions of service that contribute to attrition; (e) traditional screening techniques (e.g., psychological testing) are not very effective in preventing attrition; (f) research is needed on the factors influencing the "gatekeepers" (supervisors who make attrition decisions); (g) cost-benefit information should be determined for the tradeoff of attrition vs. the costs of retention.

The scientific and Navy communities have been apprised of this work via a briefing given by the principal investigator. Among those in attendance were representatives of the Marine Corps (Manpower Planning), Naval Material Command, Bureau of Naval Personnel, Naval Education and Training Command, and the Office of the Assistant Secretary of the Navy for Manpower and Reserve Affairs. Recency of the work precludes the reporting of any information about its impact. Funding: ONR

Goodstadt, B. E., & Glickman, A. S. The current status of enlisted attrition in the U.S. Navy and in the U.S. Marine Corps and search for remedies (Tech. Rep. AIR-54500-11/75-FR). American Institutes for Research, November 1975.

NR 170-719 EFFECTING CHANGE IN NAVY ORGANIZATIONS
University of Michigan/Bowers

The Navy manager eager to utilize the accumulated social science knowledge to improve his organization soon realizes that the characteristics of effective organizations are much better understood than are the means of imparting such characteristics to the organization. In an attempt to ameliorate this situation, a project was initiated at the University of Michigan's Institute for Social Research to study the problems encountered by managers in the implementation of organizational change. Twenty-five organizations representing a cross-section of America's large business concerns provided the data for the study including the opinions and attitudes of their workers as well as indices of work productivity and personnel turnover. Analysis focused upon the ways that organizational effectiveness is influenced by variables like the particular organizational development strategy used, the environmental factors making up the organization's "climate of opinion", technological sophistication of the organization, and the leadership styles that prevail.

While the results of this effort are described in detail in 19 technical reports, one point is worthy of note here. In the final analysis, Bowers could recommend no particular developmental technique or training procedure, such as the T-Group or job enrichment, but adopted instead an eclectic stance which holds that a wide variety might be useful depending upon diagnosed organizational need. In his view the successful develop-

COMPLETED WORK UNITS

ment program begins with and is characterized throughout by the acceptance and acknowledgement of the current state of the organization and the commitment to the proposed development activity. Thus, an emphasis upon rigorously instrumented measurement necessarily becomes the fundamental tool for implementing, monitoring, and motivating the change process. Measurement is the basis of the Survey-Guided Development approach and the skillful use of measurement forms the cornerstone of the recommendations.

Numerous efforts to inform the Navy were made. Technical reports were distributed broadly to those persons and positions concerned with issues of an organizational and developmental kind. Discussions of the findings were incorporated into numerous briefings, several at the flag level. In addition, the findings were incorporated in part into more applied work undertaken with NPRDC and the Bureau of Naval Personnel (NR 170-765). Funding: ONR

Bowers, D. G., & Franklin, J. L. Survey-guided development: Data based organizational change (Final Rep.). University of Michigan, June 1975. (AD A012 868)

NR 170-738 IMPACT OF VARIOUS LEADERSHIP APPROACHES ON ORGANIZATIONAL EFFECTIVENESS
Battelle Memorial Institute/Nealey

The relative effectiveness of several classical types of leadership power (the process by which superiors influence the work-related behavior of subordinates) was investigated in a series of studies involving several Navy settings. The use of leader power based on: (1) expert knowledge; (2) mutual trust and respect; (3) rewards; (4) coercion; and (5) rank and authority was explored by means of questionnaires administered to enlisted men at entrance and examination stations, during basic training and after two years of Navy duty. NPRDC was instrumental in obtaining the necessary permission to collect data. Power based on expert knowledge and mutual trust and respect were judged to be the most effective bases for leadership. Unfortunately, there seemed to be heavy reliance on power based on coercion and rank and authority, particularly in basic training. Experienced enlisted men were able to successfully resist leadership power if the approach taken was disliked. In a second phase of the research program, accounts of critical leadership problems were elicited from Naval officers. A sample of officers and enlisted men judged the relative effectiveness of five alternative types of leadership action vis-a-vis these problems. Again, actions that featured the use of coercion, rank and authority were shown to be less effective than alternative leadership power based on mutual respect, knowledge and reward. Eight technical reports were issued during the course of this research. The two most recent are listed below. The final report is in preparation. Funding: ONR

Thornton, G. C., III, Wood, M. T., & Nealey, S. M. Characteristics of critical leadership incidents in the Navy (Tech. Rep. 7). Battelle Memorial Institute, November 1975. (AD A018 686)

Wood, M. T., Nealey, S. M., & Thornton, G. C., III. Effects of leadership power applied to different kinds of organizational problems: A critical incident approach (Tech. Rep. 8). Battelle Memorial Institute, November 1975.

COMPLETED WORK UNITS

NR 170-740 IMPROVED INDICATORS OF MINORITY GROUP ATTITUDES AND BELIEFS
American Institutes for Research/Szalay

Recent experiments testing word association in the assessment of ethnic and racial perceptions and attitudes indicated that the utility of the association method can be expanded by using pictures as stimuli. Szalay first explored the comparative utility of word and picture stimulated associations in assessing cultural dispositions of mainland U.S. and Puerto Rican groups. The picture- and word-based inferences produced information on cultural priorities and on perceptual and attitudinal dispositions which showed an impressive degree of consistency. The picture-based method has shown advantages in flexibility in focusing on any selected area of research interest (e.g., interracial conflict, misunderstandings). The word-stimulated method, on the other hand, was easier to use in assessing generalizable cultural trends--perceptual and attitudinal. A second study tested the use of the word- and picture-based association method in the evaluation of editorials and films. The results obtained with two editorials and two films indicate that word associations offer a sensitive analytic method which reveals the perceptual and attitudinal effects of selected communications. A comparison of the two culture groups has shown that the effects of communications on the Puerto Rican and non-Puerto Rican subjects were frequently different and that these differences were generally in line with cultural dispositions identified in the first study.

Szalay has briefed several SECDEF officials at the level of Deputy Assistant Secretary, an Assistant Chief of Naval Personnel, and an Assistant Secretary of State. His techniques and/or results have been utilized at BuPers and in the Navy "Cultural Diplomacy Program" at Coronado. Funding: ONR

Szalay, L. B., & Bryson, J. A. Subjective culture and communication: A Puerto Rican-U.S. comparison (Final Rep.). American Institutes for Research, December 1975. (AD A019 162)

NR 170-741 ANALYSIS OF PSYCHOLOGICAL VARIABLES UNDERLYING ANTI-SOCIAL
BEHAVIOR
Stanford University/Zimbardo

Zimbardo's broad definition of anti-social behavior includes all actions not appropriate or normative in a given social setting as well as those that actually violate rules, laws, and moral convention. Using rigorous laboratory experiments as well as field studies, surveys, and interviews, he related causal antecedents to anti-social behaviors. Zimbardo concluded that the prediction and control of any type of anti-social behavior depends on an analysis of environmental or situational determinants rather than the characteristics of the individual. Systematic variations in anti-social behavior are more likely to be a function of social forces operating, in the present time, in the particular environment, than of internal, historical, or inherited traits and variables. A critical variable determining the occurrence of destructive anti-social behavior is that of perceived anonymity. Situational characteristics that make a person feel anonymous increase the probability that he/she will engage in aggression, cheating, stealing, or rule-breaking. People reduce the incidence and extent of their anti-social behavior when they are induced to feel "individuated" (unique, special, recognized, appreciated). The 16 technical reports produced under this project are described in the final report which is forthcoming. Four recent technical reports are listed

COMPLETED WORK UNITS

below. Work on this project has culminated in the production of materials widely used in training correctional personnel. Funding: ONR

Newton, J. W., & Zimbardo, P. G. Corrections: Perspectives on research, policy, and impact (Tech. Rep. Z-13). Stanford University, February 1975. (AD A013 172)

Zimbardo, P. G., & Haney, G. Prison behavior (Tech. Rep. Z-14). Stanford University, March 1975. (AD A013 229)

White, G. L., & Zimbardo, P. G. The chilling effects of surveillance: Deindividuation and reactance (Tech. Rep. Z-15). Stanford University, May 1975. (AD A013 230)

Zimbardo, P. G. The psychology of evil: Or the perversion of human potential (Tech. Rep. Z-16). Stanford University, May 1975.

NR 170-743 ORGANIZATIONAL FACTORS IN HEALTH AND PERSONNEL EFFECTIVENESS Naval Health Research Center/Gunderson

In conjunction with Sells of Texas Christian University, Gunderson has developed a social systems model to serve as a framework for: (1) analyzing relationships between the individual and his environment in an organizational context; and (2) evaluating the effectiveness of individuals, organizational units, and the organization as a whole. A major application of the model, and its associated methods and measurement techniques, was made aboard 20 combat ships. In this manner, the impact of environmental factors and social conditions on the health and effectiveness of men in this type of closed ecological system was determined. This required the development of objective methods for the assessment of organizational climate and of the habitability status of ships. It was discovered that health and duty status vary as a function of ship type as well as within types depending upon organizational climate. (These relationships are subtle, however, and the variables tend to be highly interdependent.) As a result of this project, Navy inhouse scientists now have available both the general model and specific assessment techniques which can contribute to an enriched appreciation of the work environment in the Navy, and the relationship between environmental factors and health. Appropriate assessment and interpretation of information of the type gathered in this research can be used to develop better management practices on individual Navy ships. The findings from the research are reported in ten technical reports which will be referenced in the forthcoming final report. Funding: ONR

Schuckit, M. A., & Gunderson, E. K. E. Alcoholism in Navy and Marine Corps women: A first look (Tech. Rep. 73-28). Naval Health Research Center, April 1975. (AD A011 294)

LaRocco, J. M., Gunderson, E. K. E., Dean, L. M., James, L. R., Jones, A. P., & Sells, S. B. Organizational and environmental factors in health and personnel effectiveness: II. Data collection methods, test instruments, and criterion variables (Tech. Rep. 75-9). Naval Health Research Center, May 1975. (AD A008 364)

Pugh, W. M., & Gunderson, E. K. E. Individual and situational predictors of illness (Tech. Rep. 75-20). Naval Health Research Center, May 1975. (AD A013 060)

COMPLETED WORK UNITS

LaRocco, J. M., Gunderson, E. K. E., & Pugh, W. M. Prediction of reenlistment: A discriminant analysis approach (Tech. Rep. 75-21). Naval Health Research Center, May 1975. (AD A010 147)

Gunderson, E. K. E. Health and adjustment of men at sea (Tech. Rep.). Naval Health Research Center, May 1975. (AD A015 965)

NR 170-745 EFFECTIVENESS OF MIXED GROUPS COMPOSED OF MINORITY AND MAJORITY SUBGROUPS
Purdue University/Castore

This project was undertaken in 1972 to provide a basis for models of collective behavior and decision making in groups characterized by distinct majority and minority viewpoints. In four separate laboratory experiments it was found that: the greater the agreement on goal priorities prior to discussion and decision making, the greater the support evidenced within the groups; and the more positive the group members were toward the decision. Members of the majority faction demonstrated greater support of the group decisions, viewing them as more representative of the views of the group as a whole. Minority faction members were less satisfied with the decisions and saw themselves as having exerted less influence than others in the decision process.

In a field experiment, groups were assembled which were either high or low on general attitude similarity as well as being either high or low on task-relevant abilities. The object was to observe the long term impact of both factors on the task performance and group cohesion. The results indicated that the major determinant of group performance was the level of relevant abilities of the group members. However, over time attitude similarity emerged as the major determinant of group cohesion, which in turn, was a major determinant of individual satisfaction with group performance. Also over time, group cohesion moved from a significant positive to a significant negative relationship with performance. ARPA representatives have been briefed on this work to access its applicability to their crisis management program. Funding: ONR

Terborg, J. R., Castore, C. H., & DeNinno, J. A. A longitudinal field investigation of the impact of group composition on group performance and cohesion (Tech. Rep. 80). Purdue University, May 1975.

NR 170-753 THE STABILITY OF VALUES DURING THE FIRST TEN YEARS OF A CAREER
Massachusetts Institute of Technology/Schein

This was a longitudinal study of how an individual integrates his personal goals with the goals and values of the organization within which he works. It was aimed at conclusions concerning the implications of organizational socialization for productivity, turnover, morale and creativity.

Schein's subjects were the graduates of the MIT MBA course in 1961, 1962, and 1963 who, before graduation, had been tested and interviewed extensively for the purpose of measuring their values, attitudes, and self-images. The present study involved re-testing and re-interviewing them ten years later.

COMPLETED WORK UNITS

Information about career histories was analyzed by Schein with a view to identifying the underlying pattern of needs of the individual (as opposed to a listing of the occupational titles he had held). Common themes which emerged from the interview data were called "career anchors". Each career anchor is a cluster of motives, values, and abilities that guides and constrains the person's career path. These psychological clusters appear to be more stable (genotypes) than the actual succession of occupational titles the person holds (phenotypes). Schein named the clusters of anchors he perceived as: (1) managerial competence; (2) technical-functional competence; (3) security; (4) creativity (or entrepreneurship); and (5) autonomy and independence.

The Navy undertakes to train a large number of people for future management and leadership positions. The more this training can be matched to enduring characteristics of the trainees, the greater the chance that post-training careers will be stable, satisfying, and productive. The implications of this research could have a bearing on the future design of Naval management training and on selection for various kinds of such training. Funding: ONR

Schein, E. G. The stability of values in the first ten years of the career (Final Rep.). Massachusetts Institute of Technology, September 1975. (AD A016 021)

NR 170-761 INTEGRATION OF EXPECTANCY THEORY AND THE CONTINGENCY MODEL OF LEADERSHIP EFFECTIVENESS
University of Washington/Mitchell

This project was conducted to clarify and integrate concepts in the field of leadership and organizational behavior. The concern was with expectancy theory and the contingency model of leadership. The two appeared to have much in common. They both used similar situational variables to describe the leadership environment and they both made similar predictions. Thus, a theoretical integration appeared to be practical. The integration of the two approaches produced some interesting results. Specifically, the expectancy theory provides a dynamic explanation about why the contingency model makes the predictions it does. It explains why a particular leader is able to obtain good performance in a specific situation. It also suggests that the most important role for a supervisor is to: (1) clarify the paths to goals for their subordinates; and (2) use those rewards and sanctions that are most highly valued by subordinates. By appropriately attending to these two factors, maximum motivation should result. The findings are reported in eight technical reports and the final report listed below. This work has been followed closely by NPRDC and was presented in detail at a 1975 symposium involving representatives of NPRDC and NHRC. Funding: ONR

Mitchell, T. R. Expectancy and expected value: Decision models for organizations (Final Rep. 75-77). University of Washington, January 1976.

COMPLETED WORK UNITS

NR 170-765 ORGANIZATIONAL RESEARCH RELATED TO THE NAVY HUMAN GOALS PLAN
University of Michigan/Bowers

During 1974 the Bureau of Naval Personnel supported this research as part of an effort to implement the Navy Human Goals Programs. The work included training sessions at Navy Human Resource Centers, the establishment of a data bank, the development of a computerized diagnostic report generator, the validation of measurement instruments, and the coordination of dissemination efforts. As a major part of the work under this contract, Bowers delineated a comprehensive computerized diagnostic procedure which not only indicates the overall state of the organization but also flags specific conditions demanding concern.

In another part of this effort, an item analysis of the Human Resource Management Survey was performed. This analysis led to the identification of 24 indices closely paralleling those found in Bowers' own Survey of Organizations. Consequent to this analysis Bowers was able to recommend major changes in the Human Resources Management Survey.

Still another part of this project brought both researchers and Navy users together at the University of Michigan for a wide-ranging symposium on the utilization of organizational indicator data. The published proceedings of that symposium make available what the editors characterize as a first attempt at a comprehensive overview of the issues involved in the use of human resource information as indicators of organizational health. These proceedings were distributed broadly throughout the Navy and the Marine Corps and have made available to the scientific community. Funding: BUPERS

Bowers, D. G. Values, practices, and human resources requirements (Final Rep.). University of Michigan, June 1975.

NR 170-769 FEASIBILITY OF ESTABLISHING A COMPUTER-CENTERED ATTITUDINAL
RESEARCH DATA BANK
R-K Research and System Design/Ramsey-Klee

This project, funded by the Navy Personnel Research and Development Center (NPRDC), involved analysis of the design requirements for a Navy computer-based attitudinal research information system. The product was a technical report (cited below) issued by NPRDC in which all aspects of such a system are discussed. Alternatives related to information indexing, data base design, user interface, hardware implementation, and cost-benefit considerations are presented along with recommendations. Some additional work growing out of the project has been funded through a contract between NPRDC and Dr. Ramsey-Klee. The technical report is being considered by a major publisher as the basis for a book on computer-based research information systems. Funding: NPRDC

Ramsey-Klee, D. M., Richman, V., & Wiederhold, G. Feasibility of and design parameters for a computer-based attitudinal research information system (Final Rep. 76-9). R-K Research and System Design, August 1975. (AD A014 551)

COMPLETED WORK UNITS

NR 170-772 A PROGRAMMED CASE ANALYSIS OF PREJUDICE AND DECISION MAKING
McBer and Company/McClelland

This project developed and evaluated techniques for objectively measuring racial bias in human inference-making processes. "Programmed cases" were developed which progress in a stepwise fashion through a series of case histories. Each participant was called upon to predict "what would happen next" at specified stages in the programmed case. He would then receive feedback about whether his choice was correct, and this information provided data for statistical analyses designed to demonstrate: (1) the extent to which an individual makes rational decisions concerning other persons; and (2) the extent to which individuals show susceptibility to the interpersonal learning interference called prejudice. The eight case histories were designed to examine the influences of race and socio-economic status. It was found that the participants showed better learning when the case was labeled with the same race as their own.

Klemp concludes that these results demonstrate the utility of the programmed case method for the study of prejudice and is planning to continue this line of research: (a) to extend it to include other potential prejudicial factors, such as sex, age, and education; (b) to consider the question of the link between prejudice as "interference with interpersonal learning" and as "behavior directed against others"; and (c) to investigate possible interventions aimed at reducing prejudicial interference with learning. The practical potential for the Navy in this research is being explored by the contractor with representatives of Pers-6. Funding: ONR

Klemp, G. O., Jr. The objective measurement of prejudice and discrimination, subtitle: Anti-prejudicial learning (Final Rep. 74-5). McBer and Company, December 1975.

NR 170-774 DIMENSIONALITY OF NATIONS
University of Hawaii/Rummel

This project was conducted to provide DOD planners with information about the future international environment as an aid to strategic and policy planning. The goals were: (a) to determine the probable nature of the future deterrence environment; (b) to assess the likelihood of future war; and (c) suggest strategies that will enhance international stability while permitting change. Between the years 1967 and 1973, some 68 technical reports were produced under this project. Four books have been written since 1973, three of which are in press. Funding: ARPA

Rummel, R. J. A summary and annotated bibliography of research by the dimensionality of nations project (Research Rep. 69). University of Hawaii, December 1973. (AD 772 100)

NR 170-776 CONTRIBUTIONS OF CONCEPTS AND DATA FROM PSYCHOLOGY AND
SOCIOLOGY TO CRISIS-MANAGEMENT DECISION MAKING
Human Sciences Research, Inc./Vreeland

The overall objective of this study was to assess, and to recommend ways of improving, knowledge about the psychological and sociological processes involved in group decision making under crisis conditions. A literature search was performed and the findings of over 100 studies were synthesized into 81 propositions that relate to the influence of individual and group

COMPLETED WORK UNITS

factors on the effectiveness of decision making tasks in crisis management. An evaluation of the research literature identified some 15 areas in which, in the judgment of the investigators, statements of relationships were well supported and could serve as the basis for policy implementation. The most important of these focused on the negative effects of time pressure, the breakdown of analytical abilities in crisis, the effectiveness of established vs. ad hoc groups, and the difficulties of information processing. Another 23 areas were identified as those in which research has produced insufficient or contradictory evidence and the subject matter is of sufficient importance to warrant further study. An analysis of the implications of the research findings for crisis management emphasized the importance of early diagnosis, adequate analyses of alternatives, factors relating to crisis management group composition and communication, and recommendations concerning the alleviation of the negative effects of stress and fatigue. Funding: ARPA

Shapiro, H. B., & Gilbert, M. A. Crisis management: Psychological and sociological factors in decision making (Final Rep. HSR-RR-75/3-Cr). Human Sciences Research, Inc., March 1975. (AD A010 211)

NR 170-778 INFORMATION FLOW AND ORGANIZATIONAL EFFECTIVENESS
University of California, Berkeley/Roberts

The primary purpose of this project was to measure, at the individual level, the work group level, and the organizational level, various perceptions of, and behaviors associated with, communications in organizations. A large amount of individual and organizational data was collected at two points in time from a Navy training squadron as it was being organized. The major outcomes were: (a) the development of a "theory of method" for doing integrative organizational research; (b) the development of a diagnostic instrument for assessing perceptions about the adequacy of organizational communication; (c) the identification of antecedents and consequences of perceptions about interpersonal communication and of communication roles people occupy in organizations; (d) the identification of relationships between communication phenomena and various aspects of organizational performance in a developing, high technology Navy organization; and (e) the demonstration that such relationships show stability over a period of one year. Twelve technical reports were produced under this project and the principal investigator advises that additional reports will be produced for publication. The principal investigator briefed the results of this research to the technical staff of the Navy Personnel R&D Center, San Diego. Funding: ONR

O'Reilly, C. A., III, & Roberts, K. H. Credibility and communication in work units (Tech. Rep. 8). University of California, June 1975. (AD A013 673)

O'Reilly, C. A., III, & Roberts, K. H. Interpersonal communication, personnel ratings, and systemic characteristics in organizations (Tech. Rep. 9). University of California, July 1975.

Roberts, K. H., & O'Reilly, C. A., III. Organizations as communication structures: An empirical-theoretical approach (Tech. Rep. 10). University of California, July 1975.

Roberts, K. H., & O'Reilly, C. A., III. Communication roles in organizations: Some potential antecedents and consequences (Tech. Rep. 11). University of California, July 1975.

COMPLETED WORK UNITS

O'Reilly, C. A., III. The intentional distortion of information in organizational communication: A laboratory and field investigation (Tech. Rep. 12). University of California, December 1975.

NR 170-779 FACTORS CONTRIBUTING TO GROUP DECISION-MAKING EFFECTIVENESS UNDER VARIOUS CONDITIONS
Purdue University/Streufert & Streufert

Task-oriented decision making is an important aspect of all levels of Navy management. Thus, the potential for enhancing overall Navy effectiveness through a clearer understanding of the effects of certain psychological variables on the quality of decision making is obvious.

In 1972 Siegfried Streufert and his associates concluded a five-year ONR-sponsored study of the effects of certain informational variables upon the decision-making process. Through the use of an imaginative simulation technique known as the Tactical and Negotiation Game, they studied the effects of information load, relevance, reliability, urgency and importance as well as the effects of the degree to which messages connoted success or failure upon a host of dependent variables characterizing the quality of decision making. Some of the results of that project reported in a lengthy series of technical reports and journal articles, strongly suggested that informational variables interact to a great degree with certain aspects of group structure and with certain characteristics of the communications network. In an attempt to ascertain the nature of these interactions, the present project was undertaken.

While much of the data analysis remains uncompleted, a sample of the preliminary findings can be mentioned. For example, one set of studies assigned game players the function of either integrating incoming information or developing strategy and making final decisions. Subjects assigned separate functions were either allowed to remain together or were assigned to separate rooms and made to communicate via telephone. The separated teams seemed more efficient on two counts: (1) Information integrators experienced very low task satisfaction when in the same room with decision makers. In this situation decision makers tended to usurp the function of the integrators. (2) Under conditions of high information load, and when separated from the decision makers, the integrators were able to reduce the amount of information flow to the decision makers.

A second example concerns the interaction between the informational variables and cognitive complexity. It should be noted that cognitive complexity is not related to intelligence but refers to the degree to which one's semantic space is both differentiated and integrated. Initially it seemed reasonable that more complex individuals ought to behave more adaptively in multifaceted situations. Thus it was hypothesized that complexity would be positively related to the optimum information load. As it turned out, this hypothesis was not supported. It was found instead that more complex individuals made "better" decisions under every information load; the optimum load was independent of cognitive complexity. Findings from this work have been discussed with the managers of other decision research programs in ONR and ARPA.

For a detailed discussion of these and other results, the reader is directed to Streufert and Streufert (1975). Funding: ONR

Streufert, S., & Streufert, S. C. Decision making: A social informational interaction process (Final Rep.). Purdue University, August 1975.
(AD A018 031)

COMPLETED WORK UNITS

- NR 170-789 DEVELOPMENT OF IMPROVED CRITERIA AND MEASUREMENT TECHNIQUES
FOR NAVY HUMAN RELATIONS PROGRAMS
System Development Corporation/Grace

This research was directed at developing improved techniques for measuring individuals' interpersonal effectiveness, in general, and inter-racial effectiveness, in particular. Analysis of Navy race relations training films resulted in identifying the facial and bodily cues that were most influential in determining an observer's perception of another individual. In addition, standardized interviews with Navy Reserve personnel who varied in interpersonal effectiveness were videotaped. Analysis of the videotapes indicated that the standardized videotaped interview approach could be useful both in selecting individuals for positions requiring good communication skills and in training personnel in communication skills.
Funding: ONR

Grace, G. L., Leung, P. W., Moran, P., & Holoter, H. A. Impact of the person on social interchange: Results of molecular cue analysis studies and methodological implications (Final Rep. TM-5135/004/00). System Development Corporation, October 1975.

- NR 170-792 INTEGRATING CONTENT ANALYSIS AND DECISION ANALYSIS IN CRISIS
MANAGEMENT
First Ann Arbor Corporation/McCormick

Part of the ARPA Crisis Management Program, this research was concerned with decisions, events, and perceptions in international crises. It was focussed on Israeli perceptions of the Arabs during the 1967 and 1973 conflicts. A content analysis scheme was devised to measure perception of threat and time pressure from publicly available documents. The results of this manual content analysis were compared with an automated content analysis of the same documents, and threat perception indices were used in conjunction with event data to statistically predict the outbreak of violent conflict. It was found that the manual content analysis index of threat perception was a good predictor of conflict, increasing sharply several days before both wars. The automated content analysis index was not as good a predictor, and the actions each side directed at the other did not predict conflict escalation with a measurable time lag. The measure of time pressure was not sufficiently sensitive to be useful. Thus, the conclusions are that a reasonable index of threat perception can be derived from the public statements of at least Israeli decision makers, and this index apparently predicts conflict much better than events alone.
Funding: ARPA

McCormick, D. M. Decisions, events and perceptions in international crises (Final Rep.). First Ann Arbor Corporation, July 1975.

- NR 170-817 REDUCING PERSONNEL TURNOVER BY IMPROVING THE QUALITY OF
ORGANIZATIONAL LIFE
Yale University/Alderfer

This effort aimed primarily at the development of theory and techniques for use in organizational development and secondarily at increased understanding of the influence of human motivation in organizational settings.

Alderfer produced seven technical reports relating to organizational development, and one TR relating to human needs. He has reviewed the

COMPLETED WORK UNITS

literature on change processes in organization, and indicated the importance of the concepts of intra-system and inter-system boundaries, boundary permeability, and mutuality relationships. He has presented a variety of case studies illustrating the utility of applying his theories and techniques to actual organizations (several large companies, a public social services department, a boarding school, and a group of staff and trainees in the Navy Human Resources Management program).

Alderfer's major methodological achievement was the development of a new technique for organizational development (which he labelled the "Peer-Group-Intergroup Model"). This approach offers distinct advantages over extant techniques in dealing with problems involving more than a single work-group or organizational level--that is, "system-wide" problems.

During this work Alderfer maintained a consulting relationship with Navy Human Resource Management personnel which helped them to incorporate the latest scientific developments into their "organizational development" efforts. Funding: ONR

Alderfer, C. P. Human needs and organizational development (Final Rep.). Yale University, October 1975. (AD A017 407)

NR 196-118 ADAPTIVE COMPUTER-AIDED CONTROL SYSTEMS
Perceptronics, Inc./Freedy

Continuous control of routine tasks unnecessarily burdens operators and detracts from accurate and timely response to extreme work loads, emergency conditions, and unexpected situations; an effective and reliable aid is foreseen in systems that store the operator's control actions, follow those movements, and finally achieve autonomous control that is subject to operator override. Human-factors criteria were derived for the application of adaptive computer-aiding in a series of experiments as a function of problem difficulty, feedback of machine state at each choice point, estimates of operator utilities for machine and manual success in both a positioning task and a simulation of remote vehicle control. Adaptive computer programs have been used to provide aiding functions of two types: (a) system control with an adaptive program that learns how to execute control actions by observing the operator's control behavior and its outcome; and (b) control allocation with an adaptive program that learns to allocate control responsibility between the operator and the computer control element. The latter type with its associated feedback display requirements was shown to be the more important factor in man-machine control. The decision model and its rules which are imbedded in the adaptive control program were refined as a result of the experimental findings so as to allocate objectively-derived values as parameters of the model when the criteria of optimum performance was specifiable beforehand but to employ utility-based allocation values when the tasks contained many judgmental factors. The man-machine subsystem that has evolved from this research has been demonstrated to be effective in terms of unburdening, consistent decision-making, overall performance, and user acceptance; these programs are seen as effective potential components for advanced remotely-piloted vehicle, robot, and manipulator systems. This research was jointly supported by the Mathematical and Information Sciences Division and the Psychological Sciences Division of ONR. Funding: ONR

Steeb, R., Artof, M., Crooks, W. H., & Weltman, G. Man/machine interaction in adaptive computer-aided control (Final Rep.). Perceptronics, Inc., December 1975.

COMPLETED WORK UNITS

NR 196-120 PILOT PERFORMANCE IN TARGET TRACKING TASKS AS A FUNCTION OF
CONTROL CHARACTERISTICS
McDonnell-Douglas Astronautics Company-East/Curtin

Manual control functions place high demands of attention and workload upon pilots, particularly in single place tactical aircraft. Although stability augmentation techniques, autopilot systems and other concepts have been developed to unburden pilots in performing primary flight tasks, little attention has been given to improved designs for manual target tracking functions. This research was concerned with investigating the effects of various tracking control characteristics and system dynamics on pilot performance. Advances in applicable design technologies were employed to develop experimental controller equipments for systematic investigation in a series of flight simulation studies. Tasks for the experiments were derived from analysis of manual control functions in high performance tactical aircraft. Principal findings include: integrated controls, mounted on the throttle, yielded more accurate target tracking than independent controls; a step output function provided faster target acquisition and more time on target than a linear function; there were significant interactions among control-display gains, control types and output functions; a modified cursor calculation technique consistently yielded more efficient target tracking than the conventional calculation method. This program was closely coordinated with the Naval Air Systems Command and its laboratories. Selected findings of this research have been incorporated by NAVAIR in preliminary design and trade-off studies for advanced tracking systems to be used on the Navy's LAMPS MK-3 ASW helicopter and on the modified TAC/NAV system for the SH-3H helicopter. Funding: ONR

Warner, H. D., Drennen, T. G., & Curtin, J. G. Manual control in target tracking tasks as a function of control characteristics: A flight simulator investigation (Final Rep.). McDonnell-Douglas Astronautics-East, December 1975.

NR 196-123 TACTILE VIBRATORY DISPLAYS FOR VEHICLE CONTROL
Sanders Associates, Inc./Ross

Increased dependence on visual and auditory modes of communication overloads operators in some normal working conditions and permits sub-optimal linkages in dark, covert, and noisy environments; direct stimulation of the skin is the sense modality that has been studied most extensively as an alternative communication mode and the outcomes showed promise for signaling events, controlling actions, and information processing. Recent materials developments have significance for the design of vibratory and electric transducers that permit the fabrication of practicable devices for transmitting multidimensional information for vehicle control. A research program for the development, evaluation, and comparison of such signaling systems in aircraft attitude control was undertaken both within the laboratory and in a moving-base F-4 simulator at NMC, Pt. Mugu, with qualified pilots. Various configurations of vibro- and electro-tactors were designed and coding formats assessed during tracking performance with and without secondary visual search tasks. In several control and monitoring tasks during approach to landing, tracking performance was not as precise as standard visual flight-displays though the error range was within acceptable limits; however, for the control of mach number during high-speed maneuvers, the tactile display permitted better performance. Sets of these tactile systems have been transferred to human-factor research scientists at NMC, Pt. Mugu for the development of an attack-signalling system and at NTEC, Orlando for the design of a status monitoring system of aircraft attitude. Funding: ARPA, ONR

COMPLETED WORK UNITS

Triggs, T. J., & Sanneman, R. A. Some experience with flight-related electro-cutaneous and vibro-tactile displays. In Geldard, F. A. (Ed.) Conference on cutaneous communication systems and devices. Austin, TX: Psychonomic Society, 1974. (AD 777 729)

Sanneman, R. A., Levison, W., & Berliner, J. Tactile displays for aircraft control (Final Rep.). Sanders Associates, Inc., April 1975. (AD A010 258)

NR 197-018X DATA BOOK FOR DESIGN OF EQUIPMENT FOR UNDERSEA WORKERS
The George Washington University/Shilling

The purpose of this work was to provide a compendium of biomedical and human performance data pertinent to the undersea environment. The document will be directed primarily to data relevant to equipment design, systems development and operational planning. The book includes sections on the effects of such factors as breathing gas mixtures, water temperature and pressure on man's physiological processes, performance and behavior; selection and training of divers; diving hazards; and diver operational equipment. This work was performed under the direction of the Biological and Medical Sciences Division, with the participation of the Psychological Sciences Division of ONR and the Bureau of Medicine and Surgery. Funding: ONR, BUMED

Shilling, C. W. (Ed.) The underwater handbook: A guide to physiology and performance for the engineer. Plenum Publishing, in press.

NR 197-021 RESEARCH ON INFERENCE AND DECISION MAKING
University of Southern California/Edwards

Part of an ARPA-funded program in advanced decision technology, this research was started in 1972 while Dr. Edwards was at the University of Michigan, and was transferred to USC in 1974. The work was concerned with three major components of the decision process: the two types of judgmental inputs--probabilities and utilities--and the combination of these inputs. The research on probabilities focused on methods of eliciting continuous probability density functions over continuous variables. Early results showed that the elicited distributions were too tight--that is, 25% to 50% of the true values fell below the .01 value or above the .99 value of the assessed subjective distributions. Further research showed that these "surprise" frequencies could be reduced by changing the elicitation procedure. Research on utilities has been hampered by lack of objective criteria against which to assess subjective value judgments. A promising approach has been identified based upon Cronbach's Theory of Generalizability, which was developed to determine how well a combination of tests measures an ability for which no "true" criterion exists. With regard to the combining of inputs, results have shown that decision analysis results are much more sensitive to errors in problem structuring and inefficient use of information than to inappropriate probabilities or utilities. Dr. Edwards and his students have published widely in the professional literature; their results are presented in addresses at professional meetings, and are discussed among researchers, practitioners and representatives of DOD agencies at an annual Bayesian meeting organized by Dr. Edwards. The results of several years of research are documented in the final technical report listed below. Funding: ARPA

COMPLETED WORK UNITS

Edwards, W. Research on the technology of inference and decision. Final technical report (SSRI Rep. 75-10). University of Southern California, August 1975. (AD A017 525)

Wheeler, G. E., & Edwards, W. Misaggregation explains conservative inference about normally distributed populations (SSRI Rep. 75-11). University of Southern California, August 1975. (AD A016 829)

Newman, J. R. Assessing the reliability and validity of multi-attribute utility procedures: An application of the theory of generalizability (SSRI Rep. 75-7). University of Southern California, July 1975. (AD A016 282)

Von Winterfeldt, D., & Edwards, W. Error in decision analysis: How to create the possibility of large losses by using dominated strategies (SSRI Rep. 75-4). University of Southern California, April 1975. (AD A017 881)

NR 197-023 ASSESSMENT OF PROBABILITIES AND UTILITIES FOR DECISION MAKING Decisions and Designs, Inc./Kelly

This research, begun in 1973, was another component in the ARPA-funded program on advanced decision technology. The purposes were to investigate procedures for improving human judgments of probabilities and utilities, conduct problem-oriented workshops for DOD personnel to demonstrate appropriate techniques applied to real problems, revise and update a handbook of decision analysis for use by managers or staff faced with decision problems, and conduct research on procedures for use in the analysis of intelligence information. The approach was principally through the use of case studies, supported by some experimental work. The case studies involved diverse problems such as the Cyprus situation, the Sino-Soviet border dispute, the estimation of NATO's response to an impending attack, policy relating to sales of computers to the Soviet Bloc, system design features and procurement policy, and two-party negotiations. Experimental work assessed different response modes for eliciting judgments. Over 30 workshops, briefings, seminars and conferences were conducted to bring these methods to the attention of senior personnel in various defense-related agencies, such as DIA, CIA, NSC, CIEP (Council on International Economic Policy), the Naval Intelligence Support Center, and others. Based on this work, an interactive computer graphics program to train analysts and to assist them in making judgments was established. Many of the findings are being incorporated into a decision aiding system now being developed for Naval Task Force Commanders. The various studies have been reported in several technical progress reports, and are summarized in the report listed below. Initial funding was jointly ONR and ARPA. Subsequently, the bulk of the funding was ARPA, with additional funds from the Navy Intelligence Support Center and the Army Electronic Systems Command.

Kelly, C. R., Peterson, C. R., Brown, R. V., & Barclay, S. Decision theory research (Tech. Rep. DT/TR 75-5). Decisions and Designs, Inc. September 1975. (AD A019 551)

COMPLETED WORK UNITS

NR 197-024 RESEARCH ON THE THEORY AND APPLICATION OF DECISION ANALYSIS
Stanford University/Howard

Begun in 1973 as part of the ARPA-funded program in advanced decision technology, this research focused on the development of the most efficient or economical models and methods for the analysis of decision problems, consistent with the amount of precision required and value obtainable. Significant advancements have been made in understanding the value of information in decision problems. When information can be purchased sequentially, the first observable has a value derived not only from its contribution to the original decision, but also its contribution to the information-purchasing decision. The value of any information depends on the prices of all the observables, and information increases in value with increased decision flexibility (i.e., number of choices). Procedures have been developed for modeling a decision maker's time preferences and risk preferences. The work has been analytical and theoretical in nature, rather than experimental, and the methodology developed by Professor Howard and his graduate students has become part of the recognized set of decision analytic procedures now being applied to a variety of defense-related problems. Funding: ARPA

Barrager, S. M. Assessment of simple joint time/risk preference functions (Rep. EES-DA-75-6). Stanford University, August 1975. (AD A018 642)

Tani, S. N. Modeling and decision analysis (Rep. EES-DA-75-3). Stanford University, June 1975. (AD A016 276)

Merkhofer, M. W. Flexibility and decision analysis (Rep. EES-DA-75-1). Stanford University, June 1975. (AD A015 290)

Miller, A. C., III. The value of sequential information (Rep. EES-DA-73-2). Stanford University, January 1974. (AD 776 610)

Rice, T. R. The economics of decision making (Rep. EES-DA-74-2). Stanford University, August 1974. (AD 786 756)

NR 197-026 BEHAVIORAL FOUNDATIONS OF DECISION ANALYSIS
Oregon Research Institute/Slovic

This research was begun in 1973 as part of the ARPA-funded program in advanced decision technology. In this component of the program, experimental and analytical studies were performed on the processes used by decision makers to deal with uncertain information, and the types of distortions or biases introduced by these processes. Biases in probabilistic judgments were found to result from such things as insensitivity to prior probabilities, insensitivity to sample size, distortions of memory for past events, and insufficient adjustment from an initial estimate or anchoring point as new information becomes available. When faced with a choice between two alternatives which are of equal overall value, decision makers choose that alternative which is superior on the more important attribute even though it was considerably inferior on a lesser dimension. Knowledge of a decision outcome distorts one's memory of his previous likelihood judgment for that outcome, raising it to conform better with reality. These findings have been widely published in scientific journals and are summarized in the final report listed below. They have been presented to many Navy audiences, including the Assistant Secretary of the Navy (R&D). The results have significant implications for the presentation of information to minimize these distortions in judgment,

COMPLETED WORK UNITS

and steps are being taken to incorporate such displays in a decision-aiding system being developed for Task Force Commanders. Funding: ARPA

Slovic, P. Behavioral foundations of decision analysis (Final Rep.). Oregon Research Institute, August 1975. (AD A015 369)

Fischhoff, B. Hindsight/foresight: The effect of outcome knowledge on judgment under uncertainty. Oregon Research Institute, April 1975. (AD A008 580)

Fischhoff, B. Temporal setting and judgment under uncertainty. Oregon Research Institute, April 1975. (AD A008 591)

RELATED PUBLICATIONS

This section contains a list of references which cite ONR support and have been published recently in the open scientific literature. Those interested in the broader substance of the research programs should find these of interest. These archival publications frequently "pull together" the results of several experiments and integrate them within the broader research domain.

- Anderson, S. B. & Ball, S. Role of the evaluator. CEDR Quarterly, 1974, 7, 16-19.
- Anderson, S. B., Ball S., & Murphy, R. T. Encyclopedia of educational evaluation. San Francisco: Jossey-Bass, 1974.
- Andriole, S. J., Wilkenfeld, J., & Hopple, G. W. A framework for the comparative analysis of foreign policy behavior. International Studies Quarterly, 1975, 19, 160-198.
- Alderfer, C. P., & Brown, L. D. Learning from changing: Organizational diagnosis and development. Beverly Hills, California: Sage Publications, Inc., 1975.
- Alderfer, C. P., Kaplan, R. E., & Smith, K. K. The effect of variations in relatedness need satisfaction on relatedness desires. Administrative Science Quarterly, 1974, 507-532.
- Atkinson, R. C. Mnemotechnics in second-language learning. American Psychologist, 1975, 8, 821-828.
- Atkinson, R. C., & Raugh, M. R. An application of the mnemonic keyword method to the acquisition of a Russian vocabulary. Journal of Experimental Psychology, 1975, 104, 126-133.
- Baddeley, A. D., Cuccaro, W. J., Egstrom, G. H., Weltman, G., & Willis, M. A. Cognitive efficiency of divers working in cold water. Human Factors, 1975, 17, 446-454.
- Barr, A., Beard, M., Lorton, P., & Atkinson, R. C. A college level course in BASIC. In G. Goos & J. Hartmanis (Eds.), Lecture notes on computer science: RGU '74. Berlin: West Germany, Springer-Verlag, 1974.
- Barr, A., Beard, M., & Atkinson, R. C. A rationale and description of a CAI program to teach the BASIC programming language. Instructional Science, 1975, 4, 1-31.
- Barr, A., Beard, M., & Atkinson, R. C. Information networks for CAI curriculums. In O. Lecarme & R. Lewis (Eds.), Computers in education (Part I). New York: American Elsevier, 1975.
- Barrett, G. W., Cabe, P. A., Thornton, C. L., & O'Connor, E. J. Relations between field dependence and reactions to changes in job attributes. Journal of Applied Psychology, 1975, 60, 649-661.
- Bass, B. M., Cascio, W. F. & O'Connor, E. J. Magnitude estimations of expressions of frequency and amount. Journal of Applied Psychology, 1974, 59, 313-320.
- Beringer, D. B., Williges, R. C., & Roscoe, S. N. The transition of experienced pilots to a frequency-separated aircraft attitude display. Human Factors, 1975, 17, 401-414.
- Bernard, H. R., & Killworth, P. D. Scientists and crew: A case study in communications at sea. Maritime Studies Management, 1974, 2, 112-125.
- Boies, S. J. User behavior on an interactive computer system. IBM Systems Journal, 1974, 13, 1-18.
- Boies, S., & Gould, J. Syntactic errors in computer programming. Human Factors, 1974, 16, 253-257.
- Bowers, D. G. OD techniques and their results in 23 organizations: The Michigan ICL study. The Journal of Applied Behavioral Science, 1973, 9, 21-43.
- Brown, R. V., Kahr, A. S., & Peterson, C. Decision analysis for the manager. New York: Holt, Rinehart, & Winston, 1974.

RELATED PUBLICATIONS

- Carver, R. P. Comparing the reading-storage test to the paraphrase test as measures of the primary effect of prose reading. Journal of Educational Psychology, 1975, 67, 274-284.
- Carver, R. P. Revised procedures for developing reading-input materials and reading-storage tests. Journal of Reading Behavior, 1975, 7, 155-172.
- Carver, R. P. The Coleman report: Using inappropriately designed achievement tests. American Educational Research Journal, 1975, 12, 77-86.
- Carver, R. P. Two dimensions of tests: Psychometric and Edumetric. American Psychologist, 1974, 29, 512-518.
- Charnes, A., Cooper, W. W., Lewis, K. A., & Niehaus, R. J. A multi-objective model for planning equal employment opportunities. In M. Zelany (Ed.) Multiple criteria decision making: Kyoto 1975, New York: Springer Verlag, 1975.
- Charnes, A., Cooper, W. W., & Niehaus, R. J. Dynamic multi-attribute models for mixed manpower systems. Naval Research Logistics Quarterly, 1975, 22, 205-220.
- Charnes, A., Cooper, W. W., Niehaus, R. J., & Sholtz, D. Multi-level models for career management and resource planning. In D. J. Clough, C. G. Lewis, & A. L. Oliver (Eds.) Manpower Planning Models, London: The English Universities Press, Ltd., 1974, 91-112.
- Coleman, R. F., & Hollien, H. Standardization of speech materials for underwater research I: Comparative intelligibility for monosyllabic word lists. Journal of Phonetics, 1975, 3, 9-16.
- Collins, A. M., Warnock, E. H., Aiello, N., & Miller, M. W. Reasoning from incomplete knowledge. In D. G. Bobrow and A. M. Collins (Eds.), Representation and understanding, New York: Academic Press, 1975, 383-415.
- Collins, A. M., Warnock, E. H., & Passafiume, J. J. Analysis and synthesis of tutorial dialogues. In G. Bower (Ed.), The Psychology of learning and motivation, New York: Academic Press, 1975, 9, 49-87.
- Dachler, H. P. Process theories of motivation in work organizations. In G. Marin & J. A. Sanchez (Eds.) Current trends in psychological research, New York: Plenum Press, in press.
- Dieterly, D. L., & Schneider, B. The effect of organizational environment on perceived power and climate: A laboratory study. Organizational Behavior and Human Performance, 1974, 11, 316-337.
- Dubin, R., & Champoux, J. E. Workers' life interests and personality characteristics. Journal of Vocational Behavior, 1975, 6, 165-174.
- Edwards, W., Thornbury, J. R., & Fryback, D. B. Studies on the diagnostic usefulness to physicians of information from the excretory urogram (IVP). In E. J. Potchen (Ed.), Current concepts in radiology II. St. Louis: Mosby Publishing Co., 1974.
- Fischhoff, B. Hindsight/Foresight: The effect of outcome knowledge on judgment under uncertainty. Journal of Experimental Psychology: Human Perception and Performance, 1975, 1, 288-299.
- Fischhoff, B., & Beyth, R. "I knew it would happen" - remembered probabilities of once-future things. Organizational Behavior and Human Performance, 1975, 13, 1-16.
- Fleishman, E. A. Toward a taxonomy of human performance. American Psychologist, 1975, 30, 1127-1149.
- Franklin, J. L. Down the organization: Influence processes across levels of hierarchy. Administrative Science Quarterly, 1975, 30, 153-164.
- Franklin, J. L. Relations among four social-psychological aspects of organizations. Administrative Science Quarterly, 1975, 20, 422-433.
- Freedy, A., Weisbrod, R., & Weltman, G. Self-optimization of task allocation in shared man/computer control. Proceedings of the IEEE Conference on Decision and Control, San Diego: CA, 1973, 784-789.

RELATED PUBLICATIONS

- Galanter, E. Psychological decision mechanisms and perception. In E. C. Carterette & M. P. Friedman (Eds.), Handbook of Perception (Vol. II). New York: Academic Press, 1974.
- Galanter, E., & Pliner, P. Cross-modality matching of money against other continua. In H. R. Moskowitz, et al. (Eds.) Sensation and Measurement: Papers in Honor of S. S. Stevens. Dordrecht, Holland: D. Reidel Pub. Co., 1974.
- Gould, J., & Drongowski, P. An exploratory study of computer program debugging. Human Factors, 1974, 16, 258-276.
- Gunderson, E. K. E. Health and adjustment of men at sea. In N. Goldman & D. R. Segal (Eds.), Proceedings of the research conference on the social psychology of military service. Chicago: University of Chicago, 1975, 164-179.
- Gunderson, E. K. E. Utilization of human resources: Summary and comment. In W. T. Singleton & P. Spurgeon (Eds.), Measurement of human resources. London: Taylor and Francis, 1975.
- Grignetti, M. C. Hausmann, C., & Gould, L. An "intelligent" on-line assistant and tutor--NLS-SCHOLAR. In Proceedings of the National Computer Conference, San Diego, California, 1975, 775-781.
- Hackman, J. R., & Morris, C. G. Group tasks, group interaction process, and group performance effectiveness: A review and proposed integration. Advances in Experimental Social Psychology, 1975, 8, 47-99.
- Hackman, J. R., Oldham, G., Janson, R., & Purdy, K. A new strategy for job enrichment. California Management Review, 1975, 17, 57-71.
- Hackman, J. R., & Oldham, G. R. Development of the job diagnostic survey. Journal of Applied Psychology, 1975, 60, 159-170.
- Hackman, J. R. & Kaplan, R. E. Interventions into group process: An approach to improving the effectiveness of groups. Decision Sciences, 1974, 5, 459-480.
- Halpern J., & Lantz, A. E. Learning to utilize information presented over two sensory channels. Perception & Psychophysics, 1974, 16, 321-238.
- Hammer, T. H. & Dachler, H. P. A test of some assumptions underlying the path goal model of supervision: Some suggested conceptual modifications. Organizational Behavior and Human Performance, 1975, 14, 60-75.
- Hausser, D. L., Pecorella, P. A., & Wissler, A. L. Survey-guided development: A manual for consultants. Ann Arbor, Michigan: Institute for Social Research, University of Michigan, 1975.
- Hill, W. A., & Ruhe, J. A. Attitudes and Behaviors of black and white supervisors in problem solving groups. Academy of Management Journal, 1974, 17, 563-569.
- Hollien, H., & Feinstein, S. Contribution of the external meatus to auditory sensitivity underwater. Journal of the Acoustical Society of America, 1975, 57, 1488-1492.
- Ince, F., Williges, R. C., & Roscoe, S. N. Aircraft simulator motion and the order of merit of flight attitude and steering guidance displays. Human Factors, 1975, 17, 388-400.
- James, L. R. Criterion models and construct validity for criteria. Psychological Bulletin, 1973, 80, 75-83.
- James, L. R., & Jones, A. P. Organizational climate: A review of theory and research. Psychological Bulletin, 1974, 81, 1096-1112.
- Jones, A. P., James, L. R., & Bruni, J. R. Perceived leadership behavior and employee confidence in the leader as moderated by job involvement. Journal of Applied Psychology, 1975, 60, 146-149.
- Killworth, P., & Bernard, H. R. Catij: A new sociometric and its application to a prison living unit. Human Organization, 1974, 33, 335-350.
- Lichtenstein, S., Earle, T. C., & Slovic, P. Cue utilization in a numerical prediction task. Journal of Experimental Psychology: Human Perception and Performance, 1975, 1, 77-85.

RELATED PUBLICATIONS

- Michaelsen, L. K. Leader orientation, leader behavior, group effectiveness and situational favorability: An empirical extension of the contingency model. Organizational Behavior and Human Performance, 1973, 9, 226-245.
- Miller, A. C., III. The value of sequential information. Management Science, 1975, 22, 1-11.
- Miller, L. Programming by non-programmers. International Journal of Man-Machine Studies, 1974, 6, 237-260.
- Norman, D. A. Learning and teaching. In P. M. A. Rabbitt & S. Dornic (Eds.), Attention and Performance V. Stockholm, Sweden. London: Academic Press, 1975.
- Norman, D. A., Rumelhart, D. E., & NLR Research Group. Explorations in cognition. San Francisco: W. H. Freeman & Co., 1975.
- O'Reilly, C. A., & Roberts, K. H. Communication: A Way of viewing organizations. National meetings of the Academy of Management, Seattle, August 1974. Proceedings, 1974, p. 63.
- O'Reilly, C. A., & Roberts, K. H. Individual differences in personality, position in the organization, and job satisfaction. Organizational Behavior and Human Performance, 1975, 14, 144-150.
- O'Reilly, C. A., & Roberts, K. H. Information filtration in organizations: Three experiments. Organizational Behavior and Human Performance, 1974, 11, 253-265.
- O'Reilly, C. A., Bretton, G. E., & Roberts, K. H. Professional employees' preference for upward mobility: An extension. Journal of Vocational Behavior, 1974, 5, 139-146.
- Pollack, I. Detection of changes in spatial position: IV Multiple display fields, display aiding, and interference. Human Factors, 1974, 16, 93-116.
- Porter, L. W., & Roberts, K. H. Organizational communication. In M. D. Dunnette (Ed.), Handbook of industrial and organizational psychology. Chicago: Rand-McNally, 1975, 1553-1589.
- Raugh, M. R., & Atkinson, R. C. A mnemonic method for learning a second-language vocabulary. Journal of Educational Psychology, 1975, 67, 1-16.
- Rigney, J. W., Computer-aided instruction for teaching integrated task performance. In O. Lecarme & R. Lewis (Eds.), IFIP 2nd World Conference on Computers in Education, Part I, New York: American Elsevier Publishing Co., Inc., 1975.
- Roberts, K. H. A thousand ways: A flexible design for behavioral research in multi-national organizations. In R. Holton & S. P. Sethi (Eds.), Management of the multi-nationals. New York: Free Press, 1974, 368-376.
- Roberts, K. H., O'Reilly, C. A., Bretton, G. E., & Porter, L. W. Organizational communication and organizational theory: A communication failure? Human Relations, 1974, 27, 501-524.
- Roberts, K. H., & O'Reilly, C. A. Measuring organizational communication. Journal of Applied Psychology, 1974, 59, 321-326.
- Roberts, K. H., & O'Reilly, C. A. Failures in upward communication in organizations: Three possible culprits. Academy of Management Journal, 1974, 17, 205-215.
- Robertson, R. M., & Williams, C. E. Effect of noise exposure during primary flight training on the conventional and high-frequency hearing of student pilots. Aviation, Space, and Environmental Medicine, 1975, 46, 717-724.
- Rogers, C. M., Rogers, M. S., Meeker, R. J., Greenstein, S., & Miner, R. L. TERS--text encoding and retrieval system. ACM Proceedings of Pacific Regional Conference 1975, Association of Computing Machinery, New York, 1975.

RELATED PUBLICATIONS

- Roscoe, S. N., & Williges, R. C. Motion relationships in aircraft attitude and guidance displays: A flight experiment. Human Factors, 1975, 17, 374-387.
- Rothman, H. B., & Hollien, H. Evaluation of HeO₂ unscramblers under controlled conditions. Journal of the Marine Technology Society, 1974, 8, 35-44.
- Schneider, B. Organizational climate: Individual preferences and organizational realities revisited. Journal of Applied Psychology, 1975, 60, 459-465.
- Schneider, B., & Bartlett, C. J. Organization Climate Questionnaire. In D. T. Hall, D. D. Bowen, R. J. Lewicki, and F. S. Hall (Eds.), Experiences in management and organizational behavior. Chicago: St. Clair Press, 1975.
- Schneider, B. & Snyder, R. A. Some relationships between job satisfaction and organizational climate. Journal of Applied Psychology, 1975, 60, 318-328.
- Sheposh, J. P., Abrams, A. J., & Licht, M. H. Assessment by technical personnel of the role of the change advocate. Journal of Applied Psychology, 1975, 60, 483-490.
- Shure, G. H., & Brainerd, K. MODELR--model building and model modification for instruction. Behavior Research Methods & Instrumentation, 1975, 7, 221-225.
- Shure, G. H., Malamuth, N., & Johnson, S. A. A computer simulation of group risky shift for teaching undergraduate research methods. Simulation & Games, 1975, 6, 202-210.
- Shure, G. H., & Meeker, R. J. Laboratory experimentation at the Center for Computer Based Behavior Studies. Behavior Research Methods & Instrumentation, 1974, 6, 241-248.
- Siegel, A. I., Fischl, M. A., & MacPherson, D. The Analytic Profile System (APS) for evaluating visual displays. Human Factors, 1975, 17, 278-288.
- Slovic, P. Choice between equally valued alternatives. Journal of Experimental Psychology: Human Perception and Performance, 1975, 1, 280-287.
- Slovic, P., & Tversky, A. Who accepts Savage's axiom? Behavioral Science, 1974.
- Steers, R. M. Role of task goal attributes, achievement, and supervisory performance. Organizational Behavior and Human Performance, 1975, 13, 392-403.
- Stone, E. F. Job scope, job satisfaction, and the protestant ethic: A study of enlisted men in the U.S. Navy. Journal of Vocational Behavior, 1975, 7, 215-234.
- Stouffer, J. L., Doherty, E. T., & Hollien, H. Effect of training on human underwater sound-localization ability. Journal of the Acoustical Society of America, 1975, 57, 1212-1213.
- Szalay, L. B. Surveying public images and opinions by the associative group analysis. Monograph for the National Bureau of Standards. Washington, D.C.: U.S. Government Printing Office, 1975.
- Szalay, L. B., & Bryson, J. A. Psychological meaning: Comparative analyses and theoretical implications. Journal of Personality and Social Psychology, 1974, 30, 860-870.
- Szalay, L. B. Adapting communication research to the needs of international and intercultural communications. International and Intercultural Communication Annual, 1974, 1, 1-16.
- Teichner, W. H., & Krebs, M. J. Visual search for simple targets. Psychological Bulletin, 1974, 81, 15-28.
- Teichner, W. H., & Krebs, M. J. Laws of visual choice reaction time. Psychological Review, 1974, 81, 75-98.

RELATED PUBLICATIONS

- Teichner, W. H. The detection of a simple visual signal as a function of time of watch. Human Factors, 1974, 16, 339-353.
- Thornbury, J. R., Fryback, D. G., & Edwards, W. Likelihood ratios as a measure of the diagnostic usefulness of excretory urogram information. Radiology, 1975, 114, 561-565.
- Tinsley, H. E. A., & Dawis, R. V. At investigation of the Rasch simple logistic model: Sample free item and test calibration. Educational and Psychological Measurement, 1975, 35, 325-339.
- Triggs, T. J., & Sanneman, R. A. Some experience with flight-related electro-cutaneous and vibro-tactile displays. In Geldard, F. A. (Ed.) Conference on cutaneous communication systems and devices. Austin, TX: The Psychonomic Society, 1974.
- Tripodes, P. G., Greenstein, S., Dolan, P., Bodnaras, M., & Shure, G. H. Automatic content coding of English text. ACM Proceedings 1974, Association of Computing Machinery, New York, 1974.
- Tversky, A., & Kahneman, D. Judgment under uncertainty: Heuristics and biases. Science, 1974, 185, 1124-1131.
- Underwood, B. J. Individual differences as a crucible in theory construction. American Psychologist, 1975, 30, 128-134.
- Underwood, B. J., & Brown, A. S. Interference in recognition memory: A replication. Bulletin of the Psychonomic Society, 1975, 5, 263-264.
- Underwood, B. J., & Reichardt, C. A. Contingent associations and the double-function, verbal-discrimination task. Memory and Cognition, 1975, 3, 311-314.
- Underwood, B. J., & Reichardt, C. S. Implicit associational responses produced by words in pairs of unrelated words. Memory and Cognition, 1975, 3, 405-408.
- Underwood, B. J., Shaughnessy, J. J., & Zimmerman, J. The locus of the retention differences associated with degree of hierarchical conceptual structure. Journal of Experimental Psychology, 1974, 102, 850-862.
- Underwood, B. J., & Reichardt, C. S., & Malmi, R. A. Sources of facilitation in learning conceptually structured paired-associate lists. Journal of Experimental Psychology: Human Learning and Memory, 1975, 1, 160-166.
- Vaughan, W. S., Jr. Diver temperature and performance changes during long-duration, cold water exposure. Undersea Biomedical Research, 1975, 2, 75-88.
- Vroom, V. H. Decision making and the leadership process. Journal of Contemporary Business, 1974, 47-64.
- Vroom, V. H., & Jago, A. G. Decision making as a social process: Normative and descriptive models of leader behavior. Decision Sciences, 1974, 5, 743-769.
- Weiss, D. J. Computerized adaptive ability measurement. Naval Research Reviews, 1975, 28, 1-18.
- Whitely, S. E. & Dawis, R. V. A model for psychometrically distinguishing aptitude from ability. Educational and Psychological Measurement, 1975, 35, 51-66.
- Zimbardo, P., Haney, C., Banks, W. C., & Jaffe, D. The psychology of imprisonment: Privation, power and pathology. In Z. Rubin (Ed.), Doing unto others: Explorations in social behavior. Englewood Cliffs, N. J.: Prentice-Hall, 1974.
- Zimbardo, P. G. On transforming experimental research into advocacy for social change. In M. Deutsch & H. Hornstein (Eds.), Applying social psychology: Implications for research, practice, and training. Hillsdale, N. J.: Lawrence Erlbaum Associates, 1975.

INDEX

CONTRACTORS

Akron, The University of, 5, 52
American Institutes for Research, 16, 50, 59, 62
American University, 19
Analytics, Inc., 45
Applied Psychological Services, Inc., 36

Battelle Memorial Institute, 61
Bolt, Beranek and Newman, Inc., 10, 11, 54
Brookings Institution, The, 30

California, University of (Irvine), 5, 57
California, University of (Berkeley), 13, 68
California, University of (Los Angeles), 22, 23
California, University of (San Diego), 7
California State University (San Jose), 4, 20
CACI, Inc., 31, 47
Carnegie-Mellon University, 25, 57
Catholic University of America, The, 39, 40
Columbia University, 38
CTEC, Inc., 46

Decisions and Designs, Inc., 41, 42, 43, 74
Delaware, University of, 21
Duke University, 26

Educational Testing Service, 48, 56

First Ann Arbor Corporation, 70
Florida, University of 24

General Research Corporation, 15, 45
George Washington University, 13, 73
Grumman Aerospace Corporation, 46

Harvard University, 25
Hawaii, University of, 67
Hay Associates, 59
Howard University, 21
Human Factors Research, Inc., 1, 36
Human Sciences Research, Inc., 27, 32, 67
Human Resources Research Organization, 11, 15

IBM, 39
Illinois, University of, 25, 35
Integrated Sciences Corporation, 46

John Hopkins University, The, 35, 38

Loyola University of Chicago, 32

Maryland, University of, 5, 29, 31, 51
Massachusetts Institute of Technology, 64
Michigan, University of, 16, 43, 58, 60, 66
Minnesota Systems Research, Inc., 22
Minnesota, University of, 3, 4, 49
Missouri, University of (Kansas City), 2

McBer and Company, 67
McDonnell Douglas Astronautics, Co.-East, 72

CONTRACTORS

Naval Health Research Center, 63
Naval Ship Engineering Center, 37
Naval Undersea Center, San Diego, 34
Navy Personnel Research and Development Center, 3, 19, 50
Nevada, University of, 42
Northwestern University, 8
North Carolina, University of, 24

Oceanautics, Inc., 35
Office of Civilian Manpower Management, 12
Ohio State University, The, 30, 31
Omnemii, Inc., 41
Operations Research, Inc., 14
Oregon Research Institute, 75
Oregon, University of, 7, 28

Pennsylvania, University of, 13, 44
Perceptronics, Inc., 33, 37, 71
Purdue University, 2, 64, 69

R-K Research and System Design, 55, 66
Rowland and Company, Inc., 6

Sanders Associates, Inc., 72
Smithsonian Institution, 17
Southern California, University of, 2, 6, 8, 28, 73
Stanford Research Institute, 44, 45
Stanford University, 9, 10, 19, 53, 62, 75
Systems and Evaluations in Education, 27
Systems Development Corporation, 14, 70

Texas Christian University, 18
Texas, University of, The, 11
Tuskegee Institute, 14

University City Science Center, 15

Washington, University of, 20, 26, 27, 65
West Virginia University, 23
Wisconsin, University of, 40
Woods Hole Oceanographic Institution, 34

Yale University, 9, 18, 21, 70

PRINCIPAL INVESTIGATORS

Abrams, A. J., 19
Alderfer, C. P., 70
Anderson, S. B., 56
Atkinson, R. C., 53

Ball, S., 56
Barrett, G. V., 5, 52
Bayton, J. A., 21
Beach, L. R., 27
Bernard, H. R., 23
Blechman, B., 30
Bobrow, D. B., 31
Bowers, D. G., 16, 58, 60, 66
Brown, R., 41

Carver, R. P., 2
Castore, C. H., 64
Castaneda, A., 27
Chapanis, A., 35
Charnes, A., 11
Cliff, N., 2
Collins, A. M., 10, 54
Connelly, E. M., 41
Crane, H., 46
Curtin, J. G., 72
Curtis, E. W., 3

Dalkey, N. C., 22
Day, H. R., 15
Day, R. S., 9
Dynes, R. R., 31

Edwards, W., 73
Egeth, H., 38

Fiedler, F. E., 20
Fisher, A. H., 59
Fleishman, E. A., 5
Frederiksen, J. R., 11
Freedy, A., 33, 71
Gaertner, S. L., 21
Galanter, E., 38
Goodman, P. S., 25
Goodstadt, B. E., 59
Grace, G. L., 14, 70
Grissmer, D. W., 15
Gunderson, E. K. E., 63

Hackman, J. R., 18
Hamburger, H. J., 57
Harman, H. H., 48
Harrell, T. W., 19
Harrington, T. L., 42
Havron, M. D., 32
Hazelwood, L. A., 31
Heffron, M., 37
Hermann, C. F., 30
Howard, J. H., 75
Howard, R. A., 40
Hulin, C. L., 25

Irving, G. W., 46
Keele, S. W., 7
Kelly, C., 42, 74
Killworth, P. D., 23

Lewin, A. Y., 26

Mackie, R. R., 1, 36
Mann, W. C., 8
Martin, W., 45
Miller, A. C., III, 45
Miller, L. A., 39
Mitchell, T. R., 27, 65
Monge, P. R., 20
Morgan, H. L., 44

McClelland, C. A., 28
McClelland, D. C., 67
McCormick, D., 2, 70
McDermott, M., 14
McGinnies, E. M., 19

Nealey, S. M., 61
Niehaus, R. J., 12
Nordlie, P. G., 27
Norman, D. A., 7
Northrup, H. R., 13

Oliver, R. M., 13

Pachella, R. G., 43
Peterson, C. R., 43
Pierce, C. M., 25
Pine, S. M., 3
Pugh, G., 45

Quarantelli, E. L., 31

Ramirez, M., III, 27
Ramsey-Klee, D. M., 55, 66
Rigney, J. W., 6
Rimland, B., 50
Roberts, K. H., 68
Robinson, G. H., 40
Ross, B. M., 39
Ross, D. H., 72
Rowland, G. E., 6
Rowney, V., 44
Rubinstein, M. F., 22
Rummel, R. J., 67
Ruhe, J. A., 24

Sarason, I. G., 26
Schein, E. H., 64
Sarkesian, S. C., 32
Schlenker, B. R., 24
Schneider, B., 5, 51
Sells, S. B., 18
Shilling, C. W., 73

PRINCIPAL INVESTIGATORS

Shure, G. H., 23
Siegel, A. I., 36
Sinaiko, H. W., 17
Slovic, P., 75
Snow, R. E., 9
Spector, B., 47
Steers, R. M., 28
Stewart, C., 13
Sticht, T. G., 11
Stone, C. H., 4
Streufert, S., 69
Streufert, S. C., 69
Stump, J. W., 46
Suppes, P., 10
Sykes, R. E., 22
Szalay, L. B., 16, 62

Thompson, G. L., 57
Thomson, G. W., 34

Underwood, B. J., 8

Vaughan, W. S., 35
Vineberg, R., 15
Vreeland, H. H., 67
Vroom, V. H., 21

Wall, P. L., 14
Weiss, D., 3, 4, 49
Weltman, G., 37
Wescourt, K., 10
Wexler, K. N., 57
Wheaton, G., 50
Wilkenfeld, J., 29
Williges, R. C., 35
Winget, C. L., 34

Zimbardo, P. G., 62